

APPLE 10.5in iPad Pro **REVIEWED!**

apc

August 2017
Issue 444

YOUR EXPERT

GUIDE TO TODAY'S TECH

THE PERFECT
BALANCE BETWEEN
POWER, PORTABILITY
& PRODUCTIVITY?
THE iPad 2-IN-1
COMES OF AGE

ENHANCE YOUR PC SETUP

THE ULTIMATE PC & LAPTOP ACCESSORIES MEGAGUIDE

+ **NEVER GO POWERLESS:** PORTABLE CHARGERS
& UNINTERRUPTIBLE POWER SUPPLIES COMPARED

LEARN THE LATEST TECH TRICKS

- HACK YOUR CAR WITH ANDROID!
- MASTER THE MAC'S PARENTAL CONTROLS
- DIY LINUX-POWERED SUPER-ROUTER
- PROLONG THE LIFESPAN OF YOUR RASPBERRY PI'S SD CARD

RED-HOT PCs & GADGETS TESTED

- MICROSOFT'S MACBOOK KILLER: SURFACE LAPTOP REVIEWED
- USB MONITOR: GET A SECOND-SCREEN ANYWHERE!
- AOC'S 27-INCH 4K GAMING SCREEN WITH G-SYNC
- NEW AMD RYZEN CPUs & MOTHERBOARDS

INTEL FIGHTS BACK

CAN THE CHIP GIANT'S PREMIUM
NEW CORE i9 CPUs & X299
BOARDS TAKE DOWN
AMD'S RYZEN?



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- VDSL2 vectoring
- 4G LTE SIM card slot (L model)
- 6 x Gigabit Ethernet LAN ports with multiple subnets and 50,000 NAT sessions
- 32 x VPN & 16 x SSL-VPN tunnels with Central VPN Management

- 2 x USB ports for 3G/4G USB modems, network printer, storage and USB thermometer*
- Built-in object-oriented Firewall
- IPv6 & IPv4
- 802.11ac (ac model)
- 802.11n (n model)
- VoIP (2 x FXS and 1 x FXO Line Port) for (V model)
- Works with VigorACS SI management system
- Central AP Management (up to 20 Access Points)
- Central Switch Management (up to 10 Switches)
- Smart Monitor Traffic Analyzer (up to 30 nodes)

* Vigor2860L/Ln only has one USB port.

Vigor2760 Series

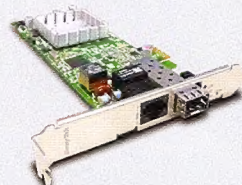
VDSL2/ADSL2+ & Gigabit Ethernet WAN router with Security Firewall, and 2 x VPN tunnels including SSL-VPN tunnels



- 1 x VDSL2/ADSL2+ WAN port
- 1 x Selectable Gigabit Ethernet WAN/LAN port
- 3 x Gigabit Ethernet LAN ports
- VDSL2 vectoring
- 2 x USB ports for 3G/4G LTE mobile broadband access, USB printer and storage
- 2 x VPN tunnels including 2 x SSL-VPN tunnels
- Built-in object-oriented firewall
- IPv6 & IPv4
- 802.11n Wi-Fi (n model)
- VoIP (V model)
- Works with VigorACS SI management system

VigorNIC 132F

VDSL2/ADSL2+ PCI Express NIC with Security Firewall, and SFP secondary WAN port



- 1 x VDSL2/ADSL2+ WAN port
- 1 x SFP port for optic fibre or UTP interface module
- VDSL2 vectoring
- Bridging for VDSL2 and ADSL2+
- Object-oriented Firewall
- IPv6 & IPv4
- Support Windows 8, Windows 10 & Ubuntu
- Multi-PVC for triple-play application
- VigorACS SI management system

Vigor130

VDSL2/ADSL2+ modem/router



- 1 x VDSL2/ADSL2+ WAN port
- 1 x Gigabit Ethernet LAN port
- VDSL2 vectoring
- Bridging for VDSL2 and ADSL2+
- Built-in object oriented firewall
- IPv6 & IPv4
- Works with VigorACS SI management system



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FIPP



The right to repair

APC's editor Dan Gardiner reckons mobile device makers need to be more forthcoming — and fair — when it comes to repair costs.

The age of the smartphone has ushered in a lot of positive effects for the technology industry as a whole and launched numerous new segments and categories, from tablets to smart speakers to Internet of Things gear and much more.

One thing it hasn't improved, however, is general repairability. As PC enthusiasts, most APC readers will know that, in a desktop PC, if your CPU fan, graphics card or other component up and dies, provided you've got a bit of technical know-how (or just good Google skills) you can generally just whip the side off the case and swap in a replacement.

While mobile devices (and I include laptops under that moniker) have always been a trickier affair, the super-slim gear that's now commonplace in the market is nigh-impossible for end-users to fix. That's OK, provided users know what they're getting when they're going in and device makers have reasonably-priced repair schemes in place.

No matter how you feel about the actual repairability of its products, it's hard to deny that Apple has been the industry leader when it comes to fixing the major killer of mobile devices — a dead battery — and making it affordable for consumers. Even in devices that can't have their

batteries easily replaced — like newer iPads, iPhones and MacBooks, for example — Apple will exchange your dead or dying device for a flat fee, ranging from \$119 to \$289. That information is also openly disclosed on Apple's website.

Microsoft, by comparison, doesn't openly state the cost of an out-of-warranty Surface Pro battery replacement on any of its sites — which, as with iPads, generally means your device is exchanged for a refurbished one, rather than actually being fixed — but most users who've had it done quote it as costing around US\$350 to US\$500.

That will undoubtedly make some shoppers think twice about who they buy a device from. If companies are going to follow Apple down the tough-to-repair road, they need to do a better job of taking care of their customers when it comes to long-term service, particularly battery replacements. ■



DAN GARDINER
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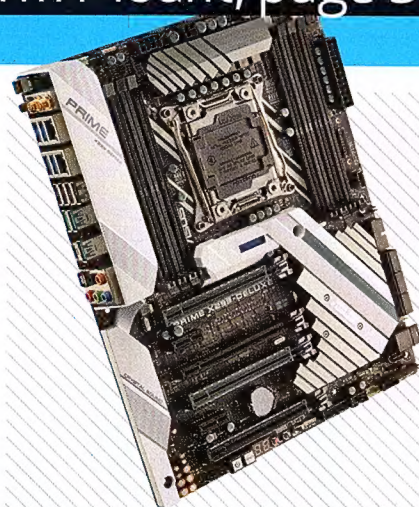
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Are our smartphones making us dumber?

"If you're not an 'IKEA person' then we'd recommend steering clear of this logical jigsaw puzzle."
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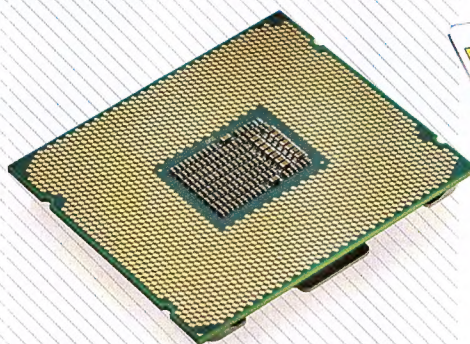
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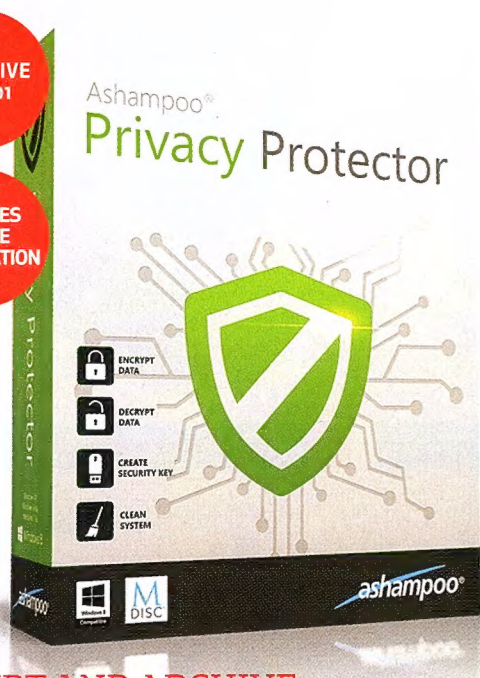
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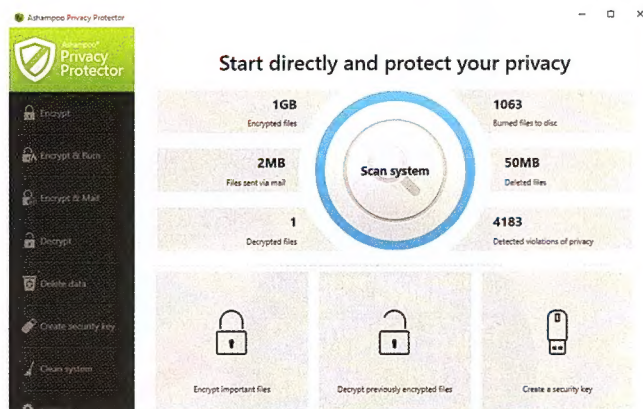
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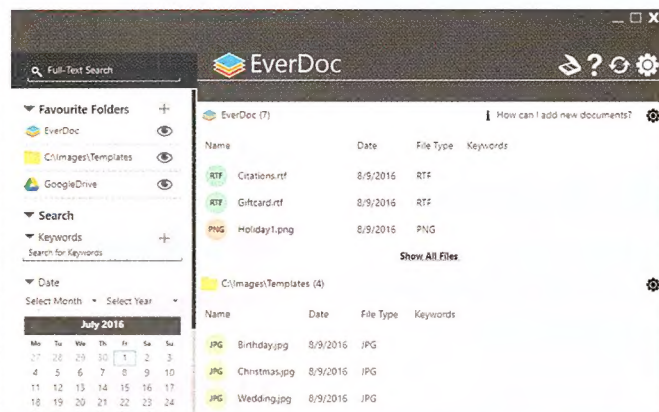
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INTEL FIGHTS BACK

CAN THE CPU GIGANT'S PREMIUM NEW CORE i7-7700X MATCH AMD'S RYZEN 7 1800X?

the lab

» LATEST REVIEWS

apc
HOT PRODUCT



Microsoft Surface Laptop

Tackling the MacBook Air with more than just surface appeal.

While its empire may have been built on software, Microsoft has had to reinvent itself in the face of changing tech times – and one area it had some surprising success in as a maker of innovative and fantastically-designed computing hardware. While Apple has always been seen as a major tech-hardware trendsetter, Microsoft has become a trailblazer in its own right, stepping up to produce a number of products that give the Cupertino company a real run for its money.

With its Surface Pro line, Microsoft virtually created the 2-in-1 market, which now completely overshadows the flatfaring tablet trade. With its more recent Surface Book convertible laptop, Microsoft engineered one of the best MacBook Pro competitors to date. And with the price yet gorgeous

Surface Studio, the Redmond company has entered the all-in-one space with a futuristic PC design that makes Apple's iMac range seem stodgy by comparison.

The real missing piece in Microsoft's PC lineup has been an affordable all-rounder laptop. With the arrival of the Surface Laptop, that gap's now been filled. This is an ultrabook – the only additional flourish being the mirrored Windows logo in the middle of its lid, giving the unit an extra level of sleek sophistication. Side-on, it looks sharp and angular like the laptop-equivalent of an '80s Lamborghini. On the left side, you'll find a single full-sized USB 3.0 port (Microsoft reckons USB Type-C still isn't ready for prime time), a mini DisplayPort output and a 3.5mm headphone jack while the right side houses the unit's power connector port and nothing else – we would've loved to have seen another USB 3.0 port on this

model, which comes with 512GB of storage, an Intel Core i7 processor and 16GB of RAM.

ANALYST'S NOTE: The first thing you'll notice about the Surface Laptop is that it's an astonishingly well-appointed piece of kit. It's got an aluminium body that, unlike Apple's more rounded MacBook products, is made up of flat, clean lines – the only additional flourish being the mirrored Windows logo in the middle of its lid, giving the unit an extra level of sleek sophistication. Side-on, it looks sharp and angular like the laptop-equivalent of an '80s Lamborghini. On the left side, you'll find a single full-sized USB 3.0 port (Microsoft reckons USB Type-C still isn't ready for prime time), a mini DisplayPort output and a 3.5mm headphone jack while the right side houses the unit's power connector port and nothing else – we would've loved to have seen another USB 3.0 port on this



Apple iPad Pro (10.5-inch)

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Intel Core i9-7900X

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Wacom Intuos 3D

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Inside APC

Find out all about APC's editorial policies, test practices, how to read the benchmark results and more.

APC is Australia's oldest consumer technology magazine – having been consistently in print for over 35 years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer – it's in our name, after all – the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech too, from smartphones and apps to peripherals, accessories, online services and beyond. We have two main goals: to track down the best of modern tech and also to help our readers make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And like you, APC's journalists want to know what's good in tech – no matter what platform it resides on.

INDEPENDENT REVIEWS

Championing technology doesn't mean we're unrelenting yes-men, however, and APC aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three.

As a matter of policy, reviews published in APC are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an APC reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

LABS TESTING

Despite being a small magazine with limited resources, APC still strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance, gaming and battery life.

In most cases, for the benchmark results published in APC, you can assume that higher is better. There are certain tests that deviate from this rule and where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter are our preference due to their ease-of-readability, but tables are more compact, so we use these in cases where thoroughness is preferred.

US visa applications now require social media details

"PASSWORD, PLEASE."

Overseas travellers applying for a US visa will now be required to provide details of their social media handles and personal biography spanning back 15 years. A new questionnaire that's to be part of the application was approved in May and is required to confirm identity or conduct more rigorous national security vetting." The US State Department estimates 65,000 people will be affected by this screening process each year. SS

CIA has the capacity to hack dozens of router models, document leak shows

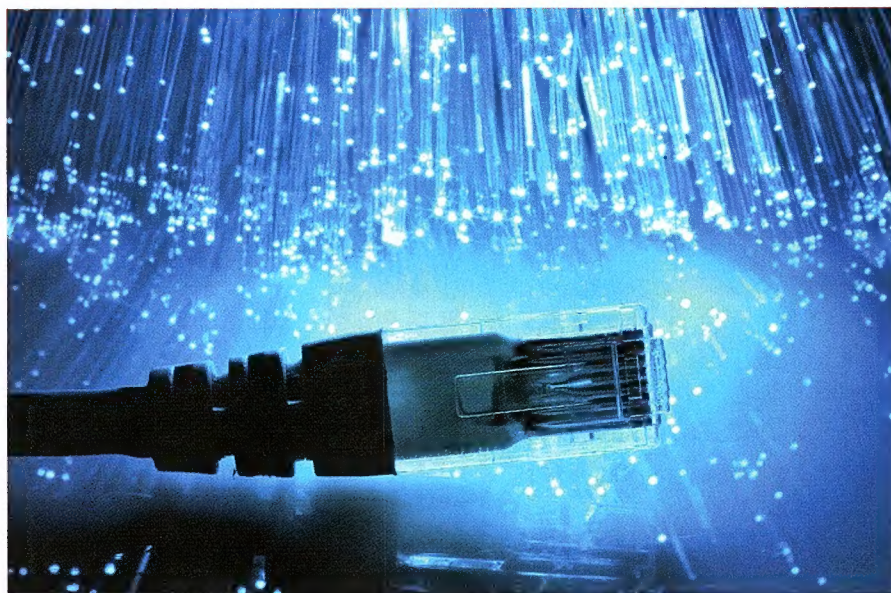
STRONG PASSWORD? MEH!

Wikileaks recently leaked a CIA user manual which gave agents instructions on how to hack a wireless router using a software called CherryBlossom. This replaces the router's firmware with a custom code, bypasses the username and a strong password, and gives CIA agents the ability to monitor internet traffic. The leaked documents also gave instructions on how to track people carrying Wi-Fi-enabled devices by triangulating their location. The Agency, strangely enough, has refused to comment on the leak or the hacking. SS

Another day, another massive ransomware attack

ALL IN A DAY'S HACK.

The dust has barely settled after the WannaCry ransomware attack and another rears its ugly head. Petya started by shutting down Russia's largest oil company, amongst others, then rapidly spread across Europe. Within hours, it had hit India and the US. Reports indicate it's even affected some Australian companies. The source of the virus is believed to be an update for a piece of Ukrainian tax software and was apparently designed to destroy files rather than hold them for ransom. SS



Kogan to sell NBN internet services starting in 2018

The fibre competition heats up.

Kogan is expanding its telecommunication services from just mobile to include reselling NBN broadband plans beginning in 2018. The online retailer's existing partnership with Vodafone has been extended by another four years, so until 2022 – and with the option of extending it by another two years – Kogan's fixed-line broadband services will be supplied using Vodafone's network. David Shafer, Kogan's executive director, said that the retailer would be "offering competitive plans" and that it was a great opportunity for the company's continued growth. "With a brand that has built a reputation for price leadership through digital efficiency, a huge online audience and a data-driven and analytical culture, Kogan.com is well poised to offer and grow a market leading NBN service," he said.

Vodafone, however, hasn't yet released any news as to when it will start providing NBN plans to customers, despite having announced last October that it would be entering the market. Sharmishta Sarkar

Australian government seeks greater powers to fight encrypted chat

TECH GIANTS' HELP NEEDED DOWN UNDER.

The Australian Government has decided to take a stance on encrypted messages and broached the subject at the Five Eyes meeting held in Ottawa recently with the other participating nations — the US, UK, Canada and New Zealand. Prior to the meeting, Attorney General George Brandis said, "I will raise the need to address ongoing challenges posed by terrorists and criminals using encryption."

Australia is pushing for greater access for law enforcement to encrypted messages sent via applications like WhatsApp and Signal, and wants large tech companies who own these platforms to be more cooperative in providing the content of the messages when asked by law enforcement.

"What we'll be asking the device makers and the ISPs to agree to is a series of protocols as to the circumstances in which they will be able to provide voluntary assistance to law enforcement," Brandis said at an interview after the meeting. Following the two-day meeting, the Five Eyes partners have agreed to engage more with the tech companies to "explore shared solutions". Sharmishta Sarkar

Google and Facebook outline steps to counter extremists online

ARMIES OF AI AND INDEPENDENT EXPERTS.

On top of the thousands of dedicated employees and automated systems that help prevent the distribution of terrorist material online, Google has unveiled additional steps it's taking to help the cause. It will devote more engineering resources and advanced machine learning to help identify the content, as well as greatly increase its amount of 'Trusted Flaggers' — independent experts monitoring YouTube. The company will also remove monetisation and comments from videos bordering on infringing its policies, and redirecting recruitment advertisements to anti-terrorist videos.

Facebook has made transparent its typically-opaque moderation strategies in a recent report that outlines efforts to shut down extremism on the social media platform. Alongside more obvious solutions like consulting with experts and law enforcement, Facebook stated it had begun using AI to stop the spread of terrorist content, including on its WhatsApp and Instagram platforms. This technology incorporates image matching, language understanding, cluster identification and other methods of learning from existing extremist behaviour and content.

HD

Digital driver's licences coming to Australia

NSW WILL BE FIRST OFF THE RANK.

The New South Wales Minister for Finance Victor Dominello has revealed the State Government's plans to begin testing digital driver's licences on the public before the end of 2017. According to the state budget, \$8.5 million will be spent on the exercise with an expected completion by 2019. So far, the Service NSW app already has some digital licences live, such as recreational fishing and responsible service of alcohol.

HD



GST coming to overseas online purchases from July 2018

eBay and Amazon aren't happy.

As of July 1, 2018, Australians will have to pay an extra 10% on any goods purchased online for less than \$1,000, both locally and overseas, as an extension of the country's existing Goods and Services Tax (GST). The tax was originally slated to hit the online sector at large July 1 this year, but the Labor Party has since moved an amendment in the Senate that requires further investigation into the most effective method of collecting this tax.

Pressure to enforce the tax initially came from local retail stores that felt the international online marketplace had an unfair advantage in being exempt from the tax. Online retailers such as eBay and Amazon have been quite vocal in arguing against the change, with the former even threatening to block online purchases entirely if the tax goes ahead in its current state. These companies believe the tax is poorly designed, comes with unnecessary complexities, and will simply send buyers to less legitimate online sources.

The Productivity Commission that Labor has requested to investigate the tax will be holding public hearings up until October 31 this year, at which point, it will report to the government on its findings.

Harry Domanski

Google will officially block 'bad' web ads in Chrome starting next year

THE FIGHT AGAINST ANNOYING (NON-GOOGLE) ADS.

Google has announced it will automatically block ads on some websites in Chrome, despite many media business models relying on display ads to keep them afloat. According to Google's senior vice president Sridhar Ramaswamy, the move is designed to eradicate "annoying, intrusive ads", rather than all forms of display advertising. When the functionality is introduced next year, the company will collaborate with 'The Coalition for Better Ads' in order to stamp out ads on "websites that are not compliant with the Better Ads Standards". Types of ads included in this non-compliant category include pop-up ads, autoplaying video ads and large sticky ads (ie. ones that cannot be clicked away). On mobile, non-compliance will mean ads that take up more than 30% of the screen and flashing animated ads, as well as auto-playing video and audio ads. Google is making efforts to help publishers on the road to compliance, though there's only six months to implement the changes. Shaun Prescott

technotes

» HARRY DOMANSKI LOOKS AT THE NUMBERS DRIVING THE BIG TECH NEWS



THE NEW WORLD RECORD FOR AN OVERCLOCKED CPU.

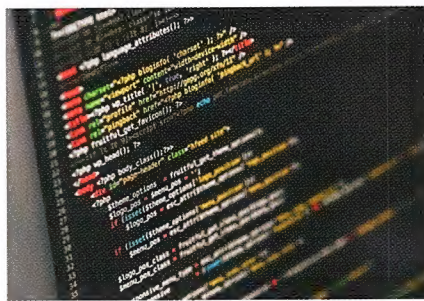
PC component manufacturer Gigabyte has set a new record for the fastest overclocked CPU by pushing an Intel chip to its limits, managing to hit a blazing 7.5GHz. The chip used in the caper was one of Intel's latest Core i7-7740K processors and it was running on Gigabyte's own X299-SOC Champion motherboard. Naturally, this feat required some intense cooling which came in the form of liquid-helium cooled to -220°C. The process was conducted by renowned overclocker and Gigabyte staffer HiCookie, along with his team of five overclockers.



50th

AUSTRALIA'S RANKING ON AKAMAI'S GLOBAL LIST OF AVERAGE BROADBAND SPEEDS.

Based on reports from US-based web company Akamai, Australia is still ranking 50th in the world for average broadband speed, which puts us significantly behind countries such as Kenya and Romania. Despite our average connection speed rising quarter-on-quarter by around 10%, this wasn't enough to bump us up any rankings on the world stage from last year. Even our average NBN speed (which was 55.7Mbps) was ranked 64th in the world for that particular category.



8.6%

THE DIFFERENCE IN SALARY BETWEEN DEVELOPERS WHO INDENT CODE WITH SPACES RATHER THAN TABS.

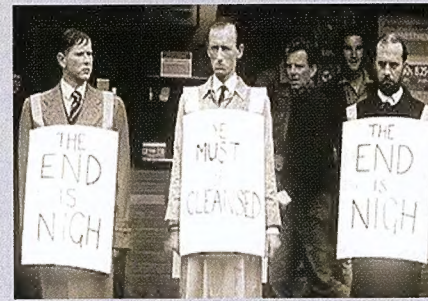
The 2017 Stack Overflow developer survey has revealed that the developers that use tab characters to indent their coding are paid significantly differently to those that use space. The findings show the median salary for the tab crew to be US\$43,750, while the spacers earned US\$59,140. Even accounting and controlling for variables such as different countries, experience levels and languages still meant that you get an extra 8.6% if you were to code with space indents. Does this end the debate?



3 million

AMOUNT OF PEOPLE ACTIVELY MINING AND STORING CRYPTOCURRENCIES.

According to a report by the Cambridge Centre for Alternative Finance, the worldwide number of people actively mining and storing cryptocurrencies is concluded to be over 3 million, a figure that more than triples most previous estimates. There's an inherent uncertainty in figures surrounding cryptocurrency due to its decentralisation, but this particular study gathered and analysed data from around 75% of the cryptocurrency industry to form its conclusion, exposing that the phenomenon is growing much faster than initially thought.



17 years

AMOUNT OF TIME ONE US AGENCY SPENT WORKING ON ITS Y2K BUG PREPAREDNESS REPORT.

In June, the Trump administration announced that several redundant paperwork systems would be retired. Among them were around half-a-dozen requirements of Federal Agencies to report on their preparedness for the Y2K bug — a fault that affected a small number of computers at the turn of the century but was blown way out of proportion. The abandoning of these reports could save up to 1,200 man-hours a year, officials at the affected agencies estimate. ■

techbrief

» SHARMISHTA SARKAR WADES INTO A CURRENT NEWS TOPIC TO TAKE A CLOSER LOOK



The rise of eSports

A game-changer for the masses and the gaming industry alike.

eSports have come a long way since the first *Space Invaders* Championship held by Atari in 1980, which attracted over 10,000 competitors across the US. The '90s saw Nintendo host a couple of international tournaments in the US, followed by TV shows in the UK, Australia and Canada broadcasting their own little competitions. Then came *StarCraft*, and its popularity in South Korea took eSports to new heights. Tournament results were announced on the evening news and a government organisation was set up in 2000 to promote and regulate eSports in the country. Today, with increased accessibility – thanks to streaming services like Twitch – and massive advertising, eSports attracts millions of viewers and players all over the globe. It's even becoming more mainstream in the West, with the last year's *League of Legends* world championship pulling in 36 million daily views and US\$6.3 million in prize money.

The number of women in eSports competitions is rising

Trying to bridging the gender gap.

Gender disparity in the gaming industry is significant, with women remaining the minority, be it in game development or in eSports. But that could change, provided women are given the right platform and men begin to respect their female counterparts. All-women tournaments are increasingly showcasing female players who are banding together to form women-only teams. The flip side to that is it prevents women from 'keeping up' with the men in the industry. Yet, women are honing their skills and making their presence felt in tournaments like Eleague's most recent televised tournament, a *Street Fighter V* invitational.

It's being researched and taught at major universities

Those who can, compete; those who can't, teach.

The Electronic Sports League (ESL) and the University of York are joining hands to set up one of the world's largest eSports research labs with an investment of US\$23 million. The lab will look into the future of competitive gaming technology and, in return, ESL will teach a course and conduct workshops on eSports content. The course will be available for third-year students starting in 2018. ESL will also provide internships to selected PhD candidates at the university, giving them hands-on experience and placements in the gaming industry.



Riot Games to create a union for eSports players

With money comes politics... and maybe even 'workers' rights.

With millions being pumped into the eSports industry, someone arguably needs to protect the competitive gamers and ensure profits are shared fairly. With that in mind, Riot Games, the creators of *League of Legends*, recently announced that the company will fund the creation of a players' association in the US – a first of its kind. There are, however, sceptics who aren't sure how this will protect the players. "Riot, I think, has good intentions. I don't think it's anything malicious," Ryan Morrison, a lawyer representing some gamers, said. "It sounds nice on paper [...] but you never want to use the attorney your boss wants you to, and that is what is happening here."

Grass sports and major Aussie banks are even signing on

Bringing in the moolah.

Following in the footsteps of ex-NBA players buying eSports teams, the Adelaide Crows Football Club has acquired Sydney-based Legacy eSports team, one of eight top-tier *LoL* professional teams competing in the Oceanic Pro League (OPL). The hope is that it would be easier to draw in potential sponsors through their trust of grass sports. Increased revenue would mean better resources for players and increased exposure for eSports in general in Oceania. And it's not just sports clubs. Seven West Media has partnered with St George Bank to launch its new eSports league and platform, called ScreenPlay. The Aussie broadcaster's chief digital officer, Clive Dickens, said the new league would promote eSports in Australia and help locals compete on the international stage. Given that Sydney just hosted the first arena-sized event in May, eSports definitely needs more air time Down Under. ■

technotes

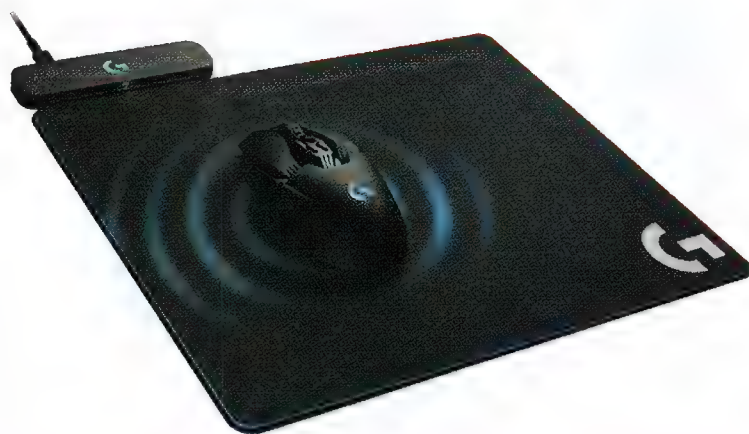
» GEAR WE WANT

LOGITECH POWERPLAY

Logitech's wireless-charging trump card.

US\$99.99 | GAMING.LOGITECH.COM

Corsair made some waves at Computex by showing off a prototype 'wireless charging' gaming mouse it called Concept Zeus. We were expecting other peripheral vendors to pick up the idea at some point. Just a few weeks later, Logitech went ahead and unveiled a fully-formed wireless charging mouse mat called Powerplay, which works with its two new wireless gaming mice, the G703 (US\$99.99) and the G903 (US\$149.99). Unfortunately, Logitech's proprietary charging system means you can't also use it as a Qi smartphone charger, but the Powerplay charging system can charge the mouse from anywhere on the mat. **JB**



BOSE SOUNDLINK REVOLVE+

The centre of the party

\$439 | WWW.BOSE.COM.AU

Bose's Sound Lantern, which the company has (in our humble opinion) incorrectly named the 'SoundLink Revolve+', is a cylindrical portable speaker with a handle that brings a formerly-unseen level of class to the spherical speaker format... and also looks unquestionably lantern-like. Utilising a clever downward-facing full-range transducer that works in conjunction with an acoustic deflector to evenly distribute sound in all directions, the Revolve Plus sounds precise from any angle and a pair of dual-passive radiators produce a controlled bass vibration for warm and powerful lower tones.

The combination makes this a rather superior audio experience for a Bluetooth speaker that's this compact. **JB**

MICROSOFT MODERN KEYBOARD

Carrying the torch of fingerprint sign-in to the PC tribe.

US\$129.99 | WWW.MICROSOFTHARDWARE.COM

Fingerprint sensors have become a standard feature across flagship smartphones and a number of professional tablet and laptop offerings, but Microsoft's self-titled 'Modern Keyboard' wants to put them on your PC, too. This fingerprint-missionary and successor to the Surface Keyboard doesn't have a heap of updated features other than the fingerprint sensor and an included cable for recharging or a wired connection, but it will be compatible with any system running Windows 10. **JB**





DJI SPARK

A teeny drone with tracking tech.

US\$499 | DJI.COM

This tiny drone measures just 14.2cm wide, 14.2cm deep and 5.6cm tall – so small that it can take off from the palm of your hand. It has several flight modes for tracking a subject (which could be you): flying backward and upward away from it, circling it or flying upward from it. It can also track and follow a subject, or fly in a direction based on where you tap on the screen. It's said to fly for 15 minutes or hover for 16 minutes in wind-free conditions. It records 1080p video at 30fps, and can take 12MP photos. We're eager to make it our plus-one at our next spring wedding... if we can get it to sit still long enough to give it its bowtie.

GARMIN VIRB 360

Capture 360-degree video and photos.

\$1,099 | GARMIN.COM

This high-end, waterproof camera for shooting 360-degree scenes can create videos up to 5.7K resolution at 30 frames per second. In that format, you'll need to perform some post-production work to stitch together the parts – mobile and desktop apps are provided for that, with varying degrees of complexity. Switch to the camera's 4K mode and you benefit from in-camera stitching and stabilisation of your video. The cam isn't just about 360-degree visuals, however; four mics capture immersive audio, too, so you can truly lose yourself in the moment you've captured. Garmin says the VIRB 360 lasts for more than an hour of constant recording.



BRAGI DASH PRO

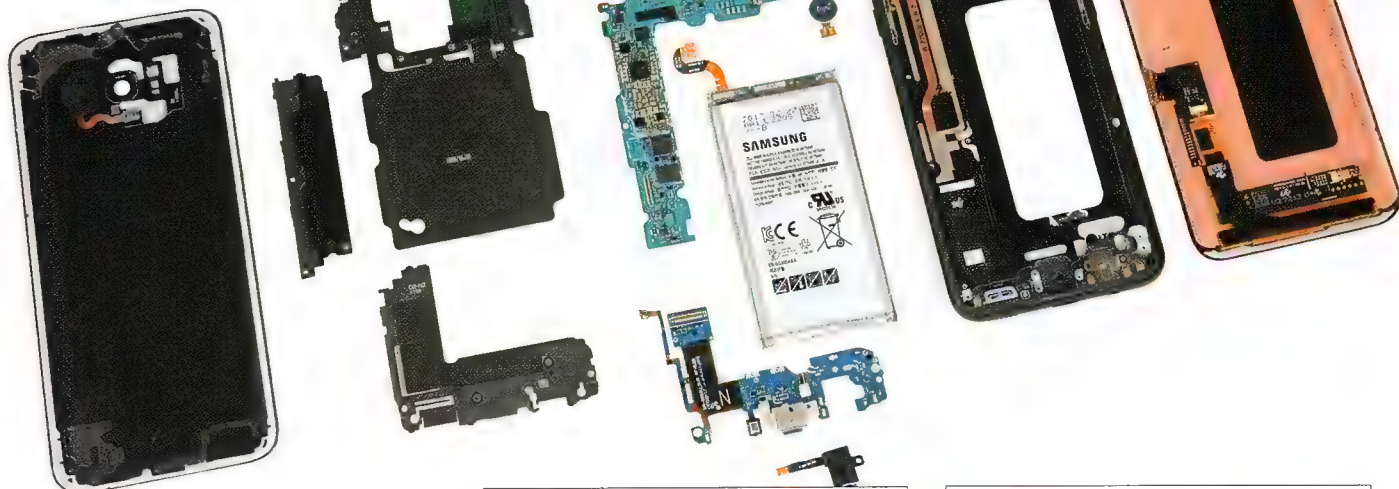
Truly wireless earphones for music and more.

€349 | BRAGI.COM

While the original Dash was designed primarily to enable you to listen to music, the Dash Pro headphones are way smarter. Their killer feature is the ability to translate language in real time using built-in iTranslate. It supports 40 different languages, allowing you to have a face-to-face conversation with someone without learning a single word of their local tongue. Mind-blowing features aside, the Dash Pro also comes with auto-tracking, so as soon as you start running/swimming/cycling, it'll automatically track your workouts without you having to do anything. Elsewhere, Bragi has made improvements to the audio balance, for a more natural sound; there's a simplified touch interface and it's easier to connect with your phone. You can even get the tips tailored to fit your lugs, for a better fit and sound.

tech

» HOW IT'S DONE



Samsung Galaxy S8+

Samsung's new flagship laid bare.

Super-sticky adhesive makes this one tough cookie to remove.



It's not often we see such a glorious-looking cooling solution as this.



Samsung is back, baby! The world's biggest smartphone maker has launched what is very nearly the world's biggest smartphone – with its monster 6.2-inch display, the Galaxy S8+ packs a visual wallop. But how will it fare on the teardown table? Let's get the exploded view.

MAJOR TECH SPECS

- 6.2-inch, dual-edge, Super AMOLED display with 2,960 x 1,440 resolution (529ppi)
- Qualcomm Snapdragon 835 processor, with 4GB RAM
- 12-megapixel rear camera with dual-pixel autofocus, and 4K video capture; 8-megapixel selfie camera
- 64GB internal storage, expandable via microSD card (up to 256GB additional)
- IP68 water resistance rating
- Android 7.0 Nougat

KEY FINDINGS

- Enough delay – we're eager to see inside. Luckily, by now, we know the drill. Plenty of heat from our iOpener softens the adhesive enough to pry the rear glass up, and start battling our way in. But for all our talk, this rear panel does present something new. The fingerprint reader lives in the rear panel, with a very short cable tying it to the motherboard. It looks

as though Samsung designed the cable to safely pull free with the rear panel. With almost no slack, the gentlest lift of the panel yanks the cable right out from its tiny pop connector. This makes it decidedly less damage-prone than certain fingerprint sensor cables we've seen before.

- Let's hope that Samsung's improved testing procedures are what the Note 7 was missing, because this design looks about the same to us. And it's still a bear to pry it off that adhesive. Even with the battery fully removed, the glue won't let go. The S8+ features a 13.48Wh (3,500mAh at 3.85V) battery – the exact same capacity as the Note 7, and a little less than the S7 Edge's 13.86Wh. Samsung continues to beat Apple in the battery capacity wars, with the iPhone 7+ weighing in at 11.1Wh (2,900mAh at 3.82V).

About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit: www.ifixit.com

- We extract the I/O daughterboard. There's lots of ingress proofing in evidence, including the speaker grille surround and the seals on the USB Type-C connector and headphone jack, with a collection of gaskets that help earn the phone its IP68 rating. The headphone jack itself remains modular – good for repairability, as this is a high-wear component.
- On a hunt for the mysterious home not-button, we dig into the display, despite previous difficulties. Luckily, this fused display/digitizer peels up from its frame with a decent struggle, but no damage. Hoping to find some hidden detail under the display cabling, we peel it up and find – zilch. No model information, and no visible pressure sensor. Better luck next time.
- **Repairability Score:** 4 out of 10 (10 is easiest to repair). Many components are modular and can be replaced independently. The battery can be replaced, but tough adhesive and a glued-on rear panel make it unnecessarily difficult to achieve. Front and back glass make for double the crackability, and strong adhesive on both makes it tough to access the internals for any repair. Because of the curved screen, replacing the front glass without destroying the display is extremely difficult. ■

ASUS[®]
IN SEARCH OF INCREDIBLE



ASUS X299 SERIES MOTHERBOARDS ABOVE AND BEYOND EXPECTATIONS



BEST-SELLING

Most motherboard sales for over 10 consecutive years, with over 500 million sold since 1989.

EASY TO USE

Our software excels at driving both performance and personalized aesthetics. ASUS 5-Way Optimization delivers one-click, system-wide overclocking and tailored cooling, while ASUS Aura Sync takes RGB lighting beyond the checkbox for orchestrated lighting symphonies controlled via a single, simple app.

STABLE

With the power-hungry X299 platform's 12-core desktop processors demanding more energy and generating more heat, our solutions for liquid and M.2 cooling are vital for superior system stability — and mean there's no need to compromise on performance.

TRUSTED

Previous-generation ASUS motherboards received 2X more awards than all other brands. But we remain devoted to engineering excellence and delivering high-performance, high-reliability products — and that's what makes ASUS the brand you can trust.

The **BEST** Motherboard — Best-selling | Easy to use | Stable | Trusted

technotes

» EPINIONS

A POSITIVE NBN EXPERIENCE

My new NBN fibre-to-the-node connection was dropping out and re-connecting over 30-40 seconds several inconvenient times a day and, after many (overseas?) phone calls and a replacement modem over several weeks, an NBN tech visited my home.

QOS testing revealed large differences between the twisted pair entering the house and my wall socket indicating a probable issue within the house.

The house had unterminated cabling for an unused Foxtel back-channel, an unused back-to-base house alarm and, due to the NBN, a now defunct telephone extension. After the techie twice climbed into the roof space to remove most of this superfluous cabling, the internal connection QOS was much improved and I have enjoyed 23+/3.5+ Mbps speeds for the past six months with no detected loss of service.

What impressed me was that the technician also checked the cabling in the pit outside the house where he found and repaired a crimp in the cable running to the house. He then traced it back to the street node to check that my copper line was via a single twisted pair rather than two single wires from separate twisted pairs, which would not have interference-cancelling properties. He explained that he'd seen this improper connection in the past.

These issues might be the cause of many of the poor NBN experiences recorded in your magazine. My house is only 13 years old in a new estate and older premises could be having problems caused by much poorer cabling and/or connections.

John Triggs

EXTREMELY POSITIVE FEEDBACK

I've just got to gush about how good a magazine APC is!

I've been a techie for 30 years, so I've seen a lot of mags come and go... and most have 'gone' because of this 'internet' thing I hear so much about. But APC is proof that the best content is still content that you pay for!



"Older premises could be having problems caused by much poorer cabling..."

My favourite things:

- **Knowledgeable writers.** The articles aren't fluff; they've got real content, and assume a decent level of competency of the reader so that they can write about the good stuff.
- **Coverage.** I'm no spring chicken to this industry, and I read voraciously online, yet I always finish an issue with at least 10 links/names to go investigate further. Well done.
- **Linux and hardware.** I really like that you've got some Linux content, and real hardware projects.
- **Real product reviews.** Information that hasn't been compromised by money is so rare... this makes your reviews very very valuable.
- **The humour and style.** From things like "Wait... what?" to "Keeping Darwinism at Bay Since 2017", the writing style and humour is so readable and accessible. I just love it. And further kudos. I've developed ASICs and FPGAs professionally. Your 'Dawn of the Accelerators'

article in the June 2017 was completely accurate. Quite a feat... further evidence of your writers' competence.

Please don't change anything!

No cost cutting, no selling of the magazine, no reducing pages, no compromise of editorial freedom... In this internet/content overload age, the quality of your content is what makes you so awesome. Don't change and you'll have a lifelong customer!

Greg Bel

Ed replies: Thank you for the kind words, Greg — it's not often we receive such overwhelming praise, so we had to read your letter a few times over to make sure you weren't being sarcastic. (We're fairly certain you weren't...) We're a small team, but we work hard to produce a mag we can be proud of each month, so it's great to hear you get a bit of enjoyment from it — and we'll continue to do our darnedest to meet your high standards in future issues. ■

APCMAG@FUTURENET.COM

Come on, have your say!

We want to hear what you think. Add to these discussions or email your views (in fewer than 250 words) to apcmag@futurenet.com. All correspondence becomes the property of APC and is subject to editing. Letters must include full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

technotes

» END USER

"It sometimes looks like a kind of plague, this obsessive fixation on a small window into the digital world."

Smartphones are killing our brains

...and not even softly — at an alarming rate, writes Shaun Prescott.



It's a sentiment we hear a lot: smartphones are making us lonelier people. They're making us closed off — anti-social and disengaged. And it's easy enough to make these claims when you're out in public, dodging oncoming foot traffic engrossed in screens. It sometimes looks like a kind of plague, this obsessive fixation on a small window into the digital world.

But in addition to their possible alienating effect, could smartphones also be reducing our capacity for critical and lateral thinking? Could they actually be making us dumb? And if they are, how do we disengage from our phones in order to re-engage with the world?

According to a recent University of Chicago study, it's demonstrably true that the presence of smartphones in our lives comes "at a cognitive cost". To elaborate, the institution tested its hypothesis that "the mere presence of one's own smartphone may occupy

limited-capacity cognitive resources". The results, predictably enough, is that indeed they do — but how does one curb this brain drain in a world increasingly reliant on phones?

The answer is a difficult one: get rid of your smartphone. Or at least, don't have it present during periods when you must concentrate. The study found a vast difference in performance between participants who had their phone at hand (ie. in their pocket, on the desk and so on) versus those who had it in another room. "[Phone-less] consumers who were engaged with ongoing cognitive tasks were able to keep their phones not just out of their hands, but also out of their (conscious) minds; however, the mere presence of these devices left fewer attentional resources available for engaging with the task at hand."

Even having one's phone visible is enough to decrease cognitive performance, with traditional tactics such as turning it face down, putting it

on silent or powering it down not working — if you can see your phone, you'll be tempted. "We therefore suggest," so says the study, "that defined and protected periods of separation... may allow consumers to perform better not just by reducing interruptions but also by increasing available cognitive capacity." Brutal.

Of course, there are subtleties or "individual differences". If you don't have a reliance on your phone but keep it at hand — for example, if you're not already using it for work or leisure purposes — you most likely won't be affected by this drop in cognitive capacity. But look at the bigger picture: if the vast majority — or even a large minority — of people are regularly having their mental resources drained by smartphones. What kind of hellish dystopia are we heading towards? (Not to mention such trifling matters as productivity and peace of mind.) Or — more alarmingly — are we already in it? ■

END USER

Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at apcmag@futurenet.com. All correspondence becomes the property of APC and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

Computex 2017's hottest new PCs, tech & trends

Asia's biggest tech showcase is always a hotbed for big PC announcements and sneak peeks at what's soon to come. Our intrepid reporters Joel Burgess & Harry Domanski braved the floor to hunt down the next big things.

While Computex 2017 wasn't quite as flamboyant as last year's VR-centric show — missing out on left-field product novelties like ASUS's Zenbo and AMD's massive Radeon 400 series GPU announcement — this year's event still carried an unmistakable amount of momentum on certain themes. This force came largely from Nvidia's new mobile GPUs, which manage to harness unprecedented levels of efficiency to pass on big weight, cooling and performance

benefits to just about every tier of gaming laptop.

The other overwhelming theme was just how reinvigorated AMD is looking. The American chip manufacturer pointed out the significant performance-per-dollar boosts its new Ryzen CPUs were achieving over Intel's incumbent Core i7 range, and the company then went on to announce a supremely-powered set of Ryzen 9 workstation CPUs and even took potshots at Nvidia by cleverly collaborating with Dell to show just how good value an AMD CPU/GPU

combination can be in all-in-one powerhouses, like the new Inspiron 27 7000.

Other notable highlights included the launch of the first HDR-capable PC gaming monitors, some interesting reductions in laptop screen latency and the arrival of Nvidia's Jetson TX2 and Isaac Initiative software — which are intended to make advanced AI more accessible and widespread — for what was, all-up, a pretty impressive Taipei display.



GAMING LAPTOPS

ASUS RoG Zephyrus

THIS ONE EARNS ITS NAME AS A GREEK WIND GOD.

Price TBA | June 27th 2017 | www.asus.com/au

Of all the laptops we saw showing off Nvidia's new Max-Q GPUs, ASUS's Zephyrus was the most dramatic by far. For starters, it manages to house a GeForce GTX 1080 GPU in its tiny 17.9mm-thick chassis (for reference, that is less than a millimetre thicker than the 2014 MacBook Air we're currently working on). Leveraging some clever engineering, the base of the unit peels open when the laptop is unfolded, allowing an entire edge to be used for unfettered airflow. Add to this solid supporting components and a reasonably quiet 42-decibel operating noise and you have an impressive new benchmark for gaming ultrabooks.

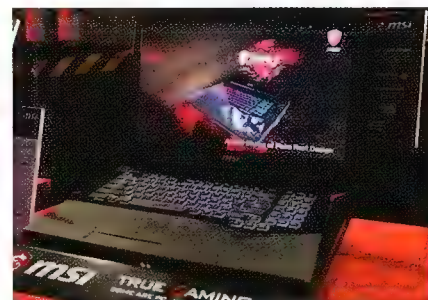


Aorus X9 Gaming Laptop

THE APEX OF AORUS.

Price TBA | October/November 2017 | www.gigabyte.com.au

Intended to be the top pillar of the Aorus X-series gaming laptops, the X9 sports a new stealth-fighter-esque lid design and a flashy eagle-shaped vent system, along with a substantial kick where it counts. The GPU is a GeForce GTX 1070 SLI — these twin 1070s are apparently capable of running at a 30% higher performance level than a 1080 — and the relatively thin body (under 30mm) manages to squeeze in a mechanical keyboard with full per-key RGB support.



MSI GT75VR Titan Gaming Laptop

AN ALL-IN-ONE GAMING SOLUTION OF TITANIC PROPORTIONS.

Price & availability TBA | au.msi.com

MSI's latest high-end offering in the realm of gaming laptops may seem closer to a desktop in size and scale when compared to some other releases at Computex this year, but it's hard to ignore some of the premium specs of this Titan. A 17-inch Ultra HD display, up to a GTX 1080 or 1070 SLI, a SteelSeries rapid RGB mechanical keyboard and, perhaps most impressively, an entirely new and super-powerful CoolerBoost Titan cooling system that allows for some serious CPU overclocking (up to 4GHz).



PC GAMING GEAR

Dell Inspiron 27 7000

PUT EVERYTHING ON RED.

Starting at US\$999 | June 2017 | www.dell.com.au

By doubling down on the use of AMD's CPUs and GPUs, Dell has made an all-in-one PC that, for the first time ever, really can do everything. Not only does this 24-inch touchscreen offer a dedicated GPU that can play the latest games on ultra settings, but the company has also slapped on the InfinityEdge display that was one of the highlights of its XPS laptops. We only have an estimate of the price, but it could even cost less than last year's range.



Gigabyte Aorus Gaming Box

TETHER SOME GPU BACKUP TO YOUR RIG.

~\$810 | June 2017 | www.gigabyte.com.au

Australians have been able to get Alienware's Alpha GPU Accelerators for some time now, but the proprietary connection interface made the product a little too niche. In what seems like one of the best expressions of a GPU accelerator, Gigabyte may have fixed this issue with the Aorus Gaming Box that was unveiled at Computex. Connecting a Nvidia GTX 1070 GPU to any computer through a Thunderbolt 3 interface, this unit will significantly speed up a large range of devices and has a pretty reasonable expected RRP.



ASUS RoG Swift PG35VQ Ultrawide Gaming Monitor

**WIDER, BETTER, FASTER...
MORE EXPENSIVE.**

Price TBA | Q4 2017 (estimated) | www.asus.com/au

The Republic of Gamers (RoG) line by ASUS has shown off its mammoth of a monitor, the RoG Swift PG35VQ, with a massive 35-inch curved, UWQHD (3,440 x 1,440) display and a 21:9 aspect ratio. With a ridiculously fast 200Hz refresh rate, Nvidia's G-Sync support, quantum dot technology and HDR, this Swift Gaming Monitor will likely make for some of the silkiest and sexiest gaming experiences available, granted you have the wallet and GeForce grunt to back it up.

ON TREND



Nvidia Max-Q Technology

MOBILE GAMING EFFICIENCY TO THE MAX.

Nvidia's newly introduced Max-Q platform is all about optimising the efficiency of the company's GPUs, delivering gaming laptops as thin as 18mm with top-of-the-line cards. Taking inspiration from NASA, Nvidia optimised the software drivers and the power regulators, without changing the underlying GPU architecture, in order to make its top-end cards — the GTX 1060, 1070 and 1080 — consume less power and create less heat. So while a laptop-bound GTX 1080 operating with Max-Q only achieves around 90% of the total performance of earlier generation mobile 1080 GPUs, this throttling means they draw only 90W of power (down from 150W), create up to 40% less heat and require significantly less cooling architecture (hence the new range of mind bendingly skinny gaming laptops).

Thunderbolt 3

A NEW STANDARD OF INTERFACE.

Free | thunderbolttechnology.net

Intel announced this year that the rights for its leading Thunderbolt 3 protocol would lapse by 2018. The chipset maker has already integrated the controller directly into its 7th generation CPUs, but the entire Thunderbolt protocol specification will soon be available royalty-free to third-party chip manufacturers. Since this interface offers 40Gbps data transfer speeds (USB 3.1 is 10Gbps), Type-C 100W power output, bi-directional PCIe and DisplayPort 1.2 communication and the ability to daisy-chain, the soon-to-be-free Thunderbolt 3 tech is looking like the new standard of universal interface.

Flaretech Prism Switch

MOVE OVER MECHANICAL, OPTICAL IS THE FUTURE.

This new concept of Prism Switches from Flaretech uses infrared optical sensors in order to detect varying degrees of pressure, as well as differentiate between short and long presses. This means that you won't need to sacrifice the quality and responsiveness of mechanical switches in order to achieve this degree of control, and they apparently come with faster response times and a longer lifespan. As a neat bonus, the switches themselves are completely waterproof and user-interchangeable, bringing with it potential for some amazing keyboard concepts.



Gigabyte Brix Gaming VR

A BIT FASTER THAN YOUR AVERAGE BRICK.

Price TBA | June 2017 | www.gigabyte.com.au

Amongst the raft of gaming laptops showed off at Computex, Gigabyte brought out a VR-ready update to its 2.6-litre Brix Mini PC that manages to keep powerful upgradable components in a compact form factor. This 11cm-wide tower is about as wide as your smartphone is long and stands a mere 22cm tall. Concealed inside is a digital origami that includes a GTX 1060 GPU, Intel 7th-gen CPU and space for two M.2 SSDs, a HDD or SATA SSD and two DDR4 RAM sticks.



Zotac VR Go

VR TO GO.

US\$1,999 | Available now | www.zotac.com

Intel showed off the WiGig wireless adapter for the HTC Vive at this year's Computex, but this kind of remote transmission technology is still some way off being consumer ready. Much like MSI before it, Zotac wants to cut the cord by strapping a VR-ready PC to your back with its new VR Go backpack. This GTX 1070-wielding PC-backpack has the added bonus of not being not pinned down by range restrictions, with two 6,600mAh Li-ion batteries that'll deliver two hours of charge each.

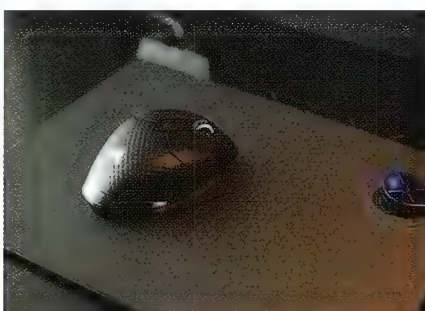


MSI G25 Vortex Gaming Desktop

MORE THAN JUST A STORM IN A TEACUP.

Price & availability TBA | au.msi.com

Last year, MSI released a cylindrical desktop gaming machine dubbed the 'Vortex', and this year, it's been reinvented as a sleek console-esque unit with the option for some serious power under the hood. The '25' in the G25 model name allegedly represents a 2.5L chassis volume and an overall 2.5kg weight, making this a seriously compact unit. You can cram the Vortex with up to a 7th-gen core i7 Intel processor, a GeForce GTX 1070 GPU, 64GB of DDR5 RAM, and up to two PCIe M.2 SSD storage.



Corsair Concept Zeus Mouse and Mousepad

PERPETUAL GAMING AT YOUR FINGERTIPS.

Price TBC | 2H 2017 | www.corsair.com

Using Qi charging technology, the Concept Zeus Mousepad from Corsair will be able to wirelessly charge both your (Concept Zeus) Mouse and phone from the pad itself. The concept, as it stands, is thin on specific details but supposedly the entire mousepad will provide a trickle charge to the mouse and will rapidly replenish it when placed in the designated zone. An adapter allows this zone to also charge your smartphone while you game, or presumably you can place your Qi-supported device directly on the area.



AND THE REST...

ASUS ZenBook Flip S

S IS FOR SLIM.

Price TBA | August 2017 | www.asus.com/au

With a byline of 'the thinnest convertible notebook', the 10.9mm-thick ZenBook Flip S made it look easy to cut through the noise at the world's biggest PC conference. Part of this is undoubtedly the 1.1kg ultra portable package, but there is also the hard-to-believe top-end specs that max out with an Intel Core i7-7500U CPU, a 1TB PCIe SSD and a 4K multi-touch NanoEdge display. To keep this full i7 CPU cool is a reengineered 0.3mm-thick liquid-crystal-polymer fan and the device even throws in one of the smallest fingerprint sensors ever implemented.



ASUS Blue Cave Dual-Band Router

THE HOLY CENTRE OF YOUR HOME NETWORK.

Price TBC | Q4 2017 | www.asus.com/au

Somewhere between sci-fi and modernism, the ASUS Blue Cave Wi-Fi Router uses a clever trick to boost the performance of its wireless signal. You may notice a giant hole in the centre of the device — this ostensibly separates the internal antennae (on the top of the titular 'blue cave') and the Intel chipset (on the bottom), thus removing interference betwixt the two. Apart from this striking design, this ASUS router handles dual-band AC2600 Wi-Fi connections and comes stocked with its new AiProtection technology, promising a secure network.



Ambi

AN INTELLIGENT AMBIENT TEMPERATURE CONTROLLER.

HK\$772 (~\$130) | July 2017

Air conditioners might not seem like the kind of thing that needs to be managed by AI, but other factors like humidity, sunlight levels, the outdoor conditions and time of day play a role alongside temperature in how comfortable the home climate is. Ambi is a Hong Kong-based Kickstarter that's turning up (or down) the heat in the automated air conditioner space. By letting Ambi's in-built AI know if you are hot, cold or comfortable, the software will weigh up the parameters and get used to delivering the temperature you like, at any time of the day.



ADATA Rugged SD700 External 512GB SSD

PROTECT YOUR DATA FROM THE ELEMENTS, AND THE APOCALYPSE.

\$430 | Available now | www.adata.com/au

The latest in durable external drives from ADATA comes in the form of the SD700 SSD, a stupendously rugged half-terabyte of external storage, promising a read/write speed of up to 440MB/s and using the latest 3D NAND Flash storage for better reliability and power efficiency. Most impressively, this compact drive has military-grade shockproof requirements and is rated IP68, meaning it can withstand some serious wetness and is completely dust-proof, making it ideal for photographers and videographers on the move in potentially inclement weather.



Cryorig TAKU

STAND UP FOR A DIFFERENT PC CASE.

US\$299 | www.cryorig.com

There were a number of excellent-looking PC cases shown off at this year's show, but most have enough LED lights, coloured coolants and vibrant metals to trigger an epileptic fit. If you want all the power of a gaming rig, but don't need your PC to dominate the room, then Cryorig's Full ITX TAKU PC case accommodates all the components you'd need and doubles as a subtle monitor stand.



Corsair K68 Keyboard

A MECHANICAL KEYBOARD BUILT TO SPILL.

\$159 | Coming soon | www.corsair.com

A silicone rubber shield protects the mechanical switches at the heart of the K68 Keyboard from Corsair, making it IP32 water- and dust-resistant. Cherry MX Red switches, fully red backlit keys, and a removable full length wrist rest make this an affordable option that tows the line between a feature-rich and mega-durable option for gamers. The keys are also fully programmable using Corsair's Utility Engine software, so the lack of macro controls won't necessarily be as much of a drawback as it may seem.



AMD Ryzen 9 Threadripper (X399) CPUs

RYZEN GOES EVEN HARDER.

Price TBA | Q3 2017 | www.amd.com

Computex is a big event for Intel, but there was no doubting that AMD stole a good chunk of attention from it this year with the announcement of an even more powerful Threadripper CPU range. The most powerful of the new Ryzen 9 CPU range will feature 16 cores and 32 threads while the whole series will get 64 PCIe lanes, quad-channel DDR4 memory and will run on the the X399 platform.



ASUS ZenBook Pro

THE ULTRABOOK GETS A TITANIUM UPGRADE.

Price TBA | August 2017 | www.asus.com/au

While ASUS's ZenBook 3 laptop was our favourite announcement of Computex 2016, its more recent sibling the ZenBook Pro has added a Nvidia GTX 1050 Ti GPU to make a laptop that is leagues ahead of the MacBook Pro in terms of graphics processing. This does cost a few millimeters of thickness against its Apple rival, squeezing into a not-so-slim 18.9mm, but when both 15-inch models weigh 1.8kg, it's a worthwhile compromise. An Intel Core i7-7700HQ CPU, a 4K display, 16GB of DDR4 RAM and a 1TB PCIe SSD adds to a rap sheet we're used to seeing on high-end gaming laptops, not ultrabooks.



All of the Surface Laptop's accessories are available in matching colours.

LAPTOP

FROM \$1,499 | WWW.MICROSOFTSTORE.COM

Microsoft Surface Laptop

Tackling the MacBook Air with more than just surface appeal.

While its empire may have been built on software, over the last five years, Microsoft has had to reinvent itself in the face of changing tech times – and one area it's had some surprising success is as a maker of innovative and fantastically-designed computing hardware. While Apple has always been seen as major tech-hardware trendsetter, Microsoft has become a trailblazer in its own right, stepping up to produce a number of products that give the Cupertino company a real run for its money.

With its Surface Pro line, Microsoft virtually created the 2-in-1 market, which now completely overshadows the flatlining tablet trade. With its more recent Surface Book convertible laptop, Microsoft engineered one of the best MacBook Pro competitors to date. And with the pricey yet gorgeous

Surface Studio, the Redmond company has entered the all-in-one space, with a futuristic PC design that makes Apple's iMac range seem stodgy by comparison.

The real missing piece in Microsoft's PC lineup has been an affordable all-rounder laptop. With the arrival of the Surface Laptop, that gap's now been filled. This is an ultrabook aimed squarely at the MacBook Air – it's perfect for students and people who don't necessarily need top-level performance in order to be productive. Starting at \$1,499 for the Core i5/128GB/4GB RAM config (which is what we tested for this review), that price makes the Surface Laptop \$50 cheaper than Apple's entry-level MacBook Air. You can go grunter if you want to, however, with Microsoft offering four Surface Laptop variants available in Australia, which each bump the price up by around \$500 and peaks with a top-of-the-line \$3,299

model, which comes with 512GB of storage, an Intel Core i7 processor and 16GB of RAM.

YOU SEXY MOTHER

The first thing you'll notice about the Surface Laptop is that it's an astonishingly well-appointed piece of kit. It's got an aluminium body that, unlike Apple's more rounded MacBook products, is made up of flat, clean lines – the only additional flourish being the mirrored Windows logo in the middle of its lid, giving the unit an extra level of sleek sophistication. Side-on, it looks sharp and angular, like the laptop-equivalent of an '80s Lamborghini. On the left side, you'll find a single full-sized USB 3.0 port (Microsoft reckons USB Type-C still isn't ready for prime time), a mini DisplayPort output and a 3.5mm headphone jack, while the right side houses the unit's power connector port and nothing else – we would've loved to have seen another USB 3.0 port on this

side, as having just one is quite limiting. What you won't see anywhere are the device's speakers – don't worry, they're just hidden under the keyboard, and they sound surprisingly good for such a slim device.

Flip the lid open and the gorgeousness continues, with a keyboard area decked out in swanky Alcantara – a synthetic suede-like material that can also be found in the interiors of many luxury cars from manufacturers like Tesla and Ferrari. That said, some car enthusiasts do think the material is overhyped, pointing out that, despite being sold as an extravagant extra, it doesn't cost much to manufacture and can also be found in the cheapest automobiles in the world. It also has a reputation for wearing quickly and becoming stained when placed in direct contact with human skin – like it will be on the Laptop's palm rests. Still, it feels smoother and less furry than you'd expect, and

Even with its sleek and slender frame, the Surface Laptop has squeezed a full-size USB 3.0 port into the mix.

we have to wonder how quickly it will become worn and dirty looking with daily use, but it's remarkably comfortable to rest your wrists on while typing — no cold metal here.

CLASSY INPUTS

Speaking of typing, the Surface Laptop's keyboard is one of the best we've ever used on a laptop, with quiet, springy keys that feel sturdy and have a nice travel distance. Below the keyboard, there's a 125mm clickable trackpad, though you can also opt to use the Surface Laptop's 13.5-inch touchscreen and stab or swipe at things with your fingers.

The IPS display is beautiful, using the Surface line's trademark productivity-friendly 3:2 aspect ratio and a slightly higher-than-usual 2,256 x 1,504-pixel resolution — well above the MacBook Air's 1,440 x 900 and more than enough to keep everything crisp and sharp. Plus, of course, there's compatibility with the Surface Pen, thanks to the inclusion of Microsoft's PixelSense touchscreen tech. The Pen is an optional extra, but grab one and you'll be able to annotate your work, draw on websites viewed on Microsoft Edge and much more. The Laptop also supports the recently released Surface Dial tool, which can add an extra layer of interactivity to design work. Its thin 10mm bezel (the MacBook Air's is around 18mm) houses a 720p webcam as well as a dedicated Windows Hello face sign-in camera, which makes logins a breeze via facial recognition.

A 'NEW' WINDOWS

The release of the Surface Laptop also marks the debut of Microsoft's newest OS, Windows 10 S. This is

essentially a streamlined version of Windows 10 Pro that, somewhat like Apple's iOS platform, implements strict limitations on third-party apps and will only let you download and install these from Microsoft's own Windows Store. Because of this approach, the Surface Laptop runs incredibly fast, with snappy performance and a boot-up time of just 15 seconds. It arguably also makes the Laptop more secure, as it completely prevents unapproved programs and executable files from running — try to launch one and you'll just get a pop-up window explaining that only Store apps (those built using Microsoft's Universal Windows Platform, or UWP, architecture) are supported by 10 S. That could be seen as either the Surface Laptop's biggest selling point or its biggest flaw, depending on what you want out of the machine and who's using it.

Of course, Microsoft tried this locked-down approach

"It's got an aluminium body that, unlike Apple's more rounded MacBook products, is made up of flat, clean lines — the only additional flourish being the mirrored Windows logo in the middle of its lid, giving the unit an extra level of sophistication. Side-on, it looks sharp and angular, like the laptop equivalent of an '80s Lamborghini."

back in 2011 with the ill-fated Windows RT, but in fairness, it's not entirely the same situation this time around. For one, the Windows Store has somewhat improved from the barren wasteland it once was: there's now over 700,000 of these UWP apps to choose from — although there are still many, many gaps in what's available.

THE APP CAPABILITY GAP

For users, the main problem is that UWP apps aren't allowed the same level of access to OS features, which means some functionality is limited and many of the more complex programs are completely AWOL from the Store. Popular media player app VLC, for instance, does offer a UWP Windows Store version, but it lacks many of the capabilities of the standard version, and the Store page description even tells prospective downloaders to seek out the 'real' version instead.

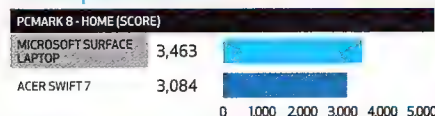
Apart from Microsoft's Office suite (Word, Excel,

PowerPoint and so on), you also won't find many 'pro' apps on the Store. Adobe's Creative Cloud suite isn't available, for example, although the consumer Elements versions of Photoshop and Premiere are on there. Another category of app you won't find is big web browsers — like Chrome, Opera and Firefox — so in that area, you're basically stuck with Microsoft Edge, which on 10 S is also locked to Bing for its search engine.

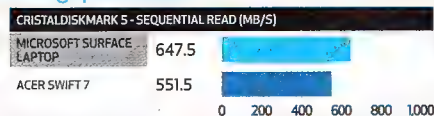
That app shortcoming isn't a complete wash, however. Many of us spend a lot of our time (both for work and play) in a web browser anyway, and Edge is a serviceable and speedy — if somewhat no-frills — way of getting around the web. Edge's functionality has also improved drastically since it first launched with Windows 10, largely thanks to the addition of extension support. There's now a decent range of these, including the likes of

LABS BENCHMARK RESULTS

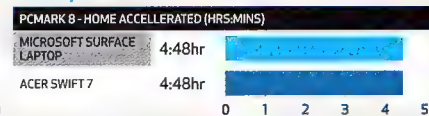
General performance



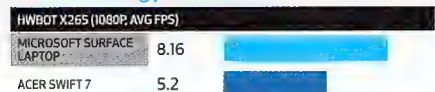
Storage performance



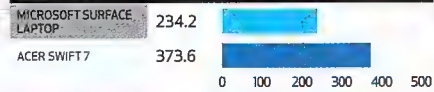
Battery life



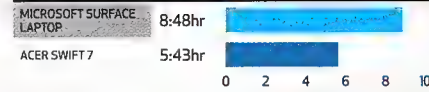
Media-encoding performance



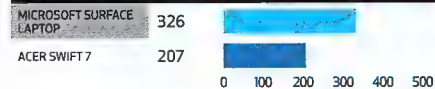
Storage performance



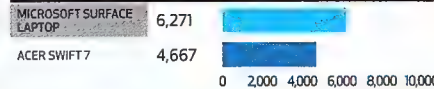
Battery life



Graphics performance



Graphics performance



We love the look and feel of the Surface Laptop's Alcantara interior, but worry it could wear quickly or get stained.

LastPass (our favourite password manager), story-saving utility Pocket, and even popular ad-blockers such as uBlock Origin and Ghostery.

And true to Microsoft's word, using the Surface Laptop with 10 S is a very slick experience – we clocked over 12 hours of movie playback, versus just under 9 hours after switching to 10 Pro.

DON'T LIKE 10 S? THEN DITCH IT!

Microsoft is hedging its OS bets on the Surface Laptop, too, and while the company would obviously prefer if you stuck with its walled-garden Windows, if you really don't like 10 S, then thankfully upgrading to Windows 10 Pro is both free and fast. Just a few confirmatory clicks and a roughly five-minute wait will seamlessly switch you over to the real-deal Windows, keeping all your data, settings and user accounts intact. This free upgrade is available until the end of 2017; it's still

available after that, but will cost you AU\$75.

So how does the device perform with Windows 10 Pro? Still quite well, as it happens. Most of our benchmarks were unable to run on 10 S, making a direct objective comparison between it and 10 Pro rather difficult, the Surface Laptop still did well compared to other ultrabooks, lasting around 5 hours in the tough PCMark 8 Home (Accelerated) battery test – from experience, we've found that's enough to get you a good 7–8 hours screen time with low to moderate use.

Elsewhere, the Laptop's performance results were about on par for a midrange Core i5 device – it's certainly capable of the day-to-day basics, including photo editing and even a bit of 1080p video editing. The only slightly sore spot we found was the SSD – it's got nice fast read speeds, topping out at around 650MB/s, but write speeds lag behind at about half that. They're definitely less

than they should be for what's otherwise a 'premium' device, and well behind the NVMe SSD that's in the Surface Pro or the Dell XPS 13.

DOES WINDOWS FINALLY HAVE ITS MACBOOK AIR KILLER?

There's no denying that, in most areas, this is one of the most appealing Windows ultrabooks we've ever tested. The build-quality is first-rate in most areas, and it manages to replicate the 'tough and robust but still friendly' feel that's helped make Apple's MacBook Air so popular.

Windows 10 S also turns out to be a bit of a non-issue. The fact that Microsoft is letting buyers upgrade to Windows 10 Pro for free – and that this process is so quick and seamless – means that buyers can play around with 10 S for a day or two and see if it suits. If it doesn't, you can switch to the 'real' version of Windows in under five minutes.

For a device of this calibre, the price is fair too. Yes,

there's a bit of the Australia Tax here (this entry-level model sells for US\$999 in the States) but that's par for the course with ultrabooks.

So does this beat our previous favourite Windows ultrabook, Dell's XPS 13? That's almost impossible to answer and will come down to personal preference – but the Surface Laptop's slightly cleaner and leaner design and 3:2 display will certainly win a lot of converts in that contest.

Not quite an XPS 13 or MacBook Air beater, then – but certainly an equal almost everywhere that matters.

■ Stephen Lambrechts & Dan Gardiner

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

One of the most premium Windows laptops we've seen, and the free OS upgrade makes 10 S a non-issue.

★★★★★

Our telecommunication capability can grow
your business in entirely new ways.
Stay connected. Stay secured.



CAT.6



- ✧ Triple-WAN approach –VDSL2, ADSL2+, 3G/4G LTE or Ethernet WAN for broadband connectivity
- ✧ 3G/4G LTE embedded with dual-SIM card slots
- ✧ Support LTE CAT 6; up to DL:300Mbps and UL:50Mbps
- ✧ Auto Failover/ Fallback feature to ensure an always-on connection
- ✧ 16 IPSec VPN tunnels supported

BiPAC 8920NZ

M2M Dual-SIM 3G/4G LTE Embedded V/ADSL2+
Wireless-N VPN Firewall Router



BILLION

The new Surface Pen, Surface Pro Signature Type Cover and Surface Arc Mouse come in a range of colours and are available separately for \$TBC, \$249.95 and \$119.95.



The all new Surface Dial offers an innovative way for creatives to interact with their software and is compatible with the Surface Pro.

TABLET

FROM \$1,199 (\$3,299 AS TESTED) | WWW.MICROSOFTSTORE.COM

Microsoft Surface Pro (2017)

Microsoft's ditched the model numbers for its latest Surface Pro, but has much actually changed in the underlying device?

Depending on who you ask, Microsoft's new Surface Pro is either a minor update to the Surface Pro 4 or an overhaul of the entire system that leaves few elements unchanged. In many ways, it's both.

The Surface Pro has been endowed with a full motherboard redesign, a larger battery, an updated Intel CPU and a reconfigured thermal design... but when you sit it next to its predecessor, it's rather difficult to tell them apart.

The 2017 edition sees the return of the 12.3-inch, 10-point multi-touch display at the 3:2 aspect ratio that the entire Surface family shares. This vibrant 2,736 x 1,824, 267ppi screen was first seen on the Surface Pro 4 back in 2015, yet it still offers a higher overall resolution than most of today's premium laptop and pro tablet offerings, so the fact that the resolution hasn't been increased this year is, frankly, a non-issue.

Other than the screen and physical ports, almost everything else is new. The most distinctive design novelty is the recessed fan grill that takes a more subtle form and increases the curvature of the tablet's edges, and does so without compromising airflow. The 1080p 5MP and 8MP front and rear cameras have been coloured to blend into the bezel and magnesium chassis, and the hinge has been reengineered to reduce the number of components and increase the display viewing-degree range from 150° on the Surface Pro 4 to 165° on this 2017 model.

The Microsoft team made a point of highlighting the fact that it's focused on bolstering the hardware reliability of the Surface Pro, something that will be reassuring for anyone who owned a Surface Pro 4, but doing this required a number of internal reconfigurations that added very little to the specs sheet. Top of that list of changes is a motherboard

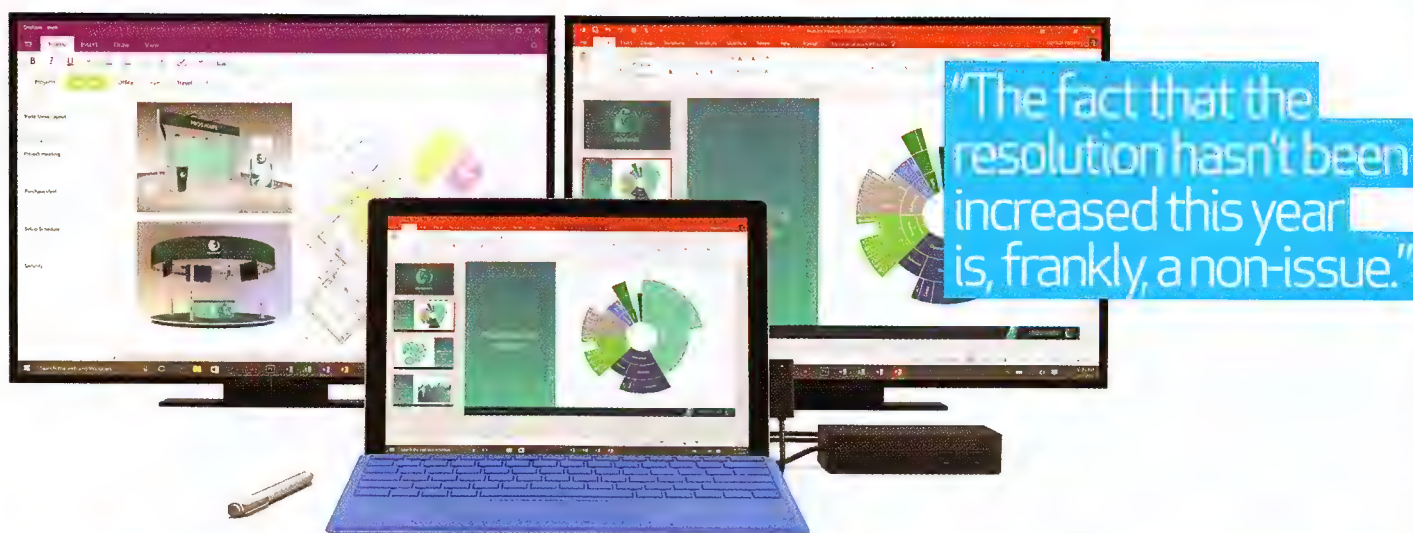
revamp that accommodates the three 7th-gen Intel CPU variations the Surface now comes in (Core m3, i5 and i7) and also freed up an extra 10% of space for the battery. Microsoft says this allows the unit to have up to 30% greater battery life than the Surface Pro 4. In our tough PC Mark Home (Accelerated) battery test, the new 2017 Pro managed 4 hours and 23 minutes compared to the Pro 4's 3 hours and 48 minutes, a difference of about 15%.

Microsoft has also rebuilt the entire cooling system by transitioning from copper thermal pipes to a graphite composite and increasing the number of heat sinks from one to four. These dramatic changes to the thermal architecture allow the Core M and the i5 models to come without fans and, Microsoft says, for the entire Surface Pro range to reduce surface hotspots, draw less power and put less strain on the components over time.

Considering all the important ground work

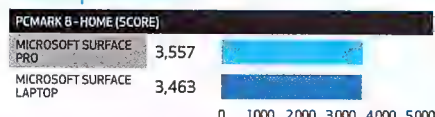
that's been done to future-proof the Surface Pro, we were perplexed to see that there's no inclusion of the now nearly-ubiquitous USB Type-C port, instead sticking with the keyboard-cover connector, power input, USB 3.0 Type-A, mini-DisplayPort, microSD card reader and a 3.5mm headphone jack. There are plans to release a Surface Connect to Type-C adapter later in the year, however.

There are still some broader caveats — the most notable being the low performance-to-price ratios involved, relative to laptops. That means that, although the Surface Pros can still deliver bleeding-edge performance, you'll have to pay for it. With three CPUs on offer, performance will depend on the Intel Core m3, the Core i5 or the Core i7 model you purchase. Additionally, 4GB, 8GB and 16GB RAM configurations and 128GB, 256GB, 512GB and 1TB storage options are available locally, giving you

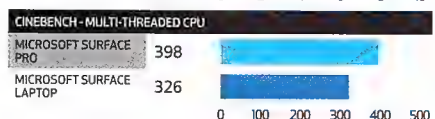
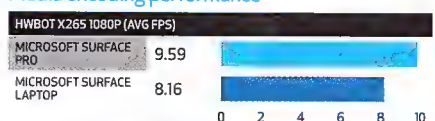


LABS BENCHMARK RESULTS

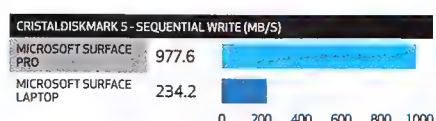
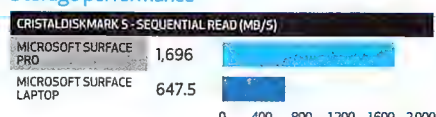
General performance



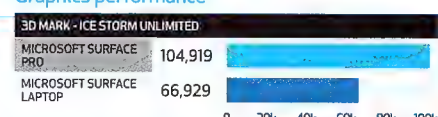
Media encoding performance



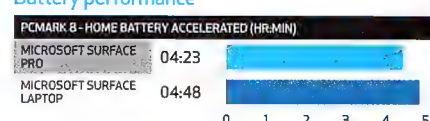
Storage performance



Graphics performance



Battery performance



models that range in price from just \$1,199 all the way to \$3,999.

The Core i7-7660U, 16GB RAM, 512GB Samsung SSD configuration we tested performed almost as well as the latest iPad Pro on GeekBench 4. Against Windows-based machines, this top-end Pro does particularly well too, even when compared with premium laptops like the similarly specced Toshiba Portégé X20W-D (reviewed in APC 441, page 27). With a PCMark 8 Creative score of 4,550 it has more than enough horsepower to run Adobe's demanding Creative Suite alongside whatever else you want to. In storage read speed testing, the Pro's PCIe-connected SSD scored around 10% better than what's in the Surface Pro 4, and made very considerable headway on sequential write speeds, which jumped from 291.3MB/s to 977.6MB/s.

However, when pushed with CPU-heavy tasks like media encoding, the highest

spec'd Surface Pro's Core i7-7660U chip reaches the CPU's max temperature of 100°C. For general tasks, we found that this didn't cause performance problems, but if you're considering a higher-end unit, be wary that the i7 CPUs will start to throttle performance and won't always perform at their full potential when they reach their top temperature.

The Surface Pro doesn't have quite the same level of instant-on architecture as what can be achieved with the Surface Laptop when running Windows 10 S, but it still manages to boot to the desktop in a speedy 18 seconds including Windows Hello Sign In. Sound output via the built-in speakers has also received a decent improvement. Although all 2017 models are Wi-Fi only at present, Microsoft did announce plans to add LTE, SIM- and eSIM-compatible Surface Pro units to the lineup later in the year.

There have been some accessory improvements,

too. For \$250 (a \$50 premium on the existing Type Cover), the new Signature Type Cover keyboard adds LED backlighting, an even silkier glass trackpad and continues the use of the (premium-ish) synthetic Alcantara fabric for a soft, velvety palm feel. The ~\$100 Surface Pen sees a dramatic boost to its feature set, with four times the pressure sensitivity levels of its predecessor (totalling 4,096), added tilt sensitivity for sketching and a more sensitive initial contact threshold. These upgrades are great but when neither come bundled with the Surface Pro, you'll have to add \$350 to the total price if you want both.

By removing the model number from its name, Microsoft is asserting its intent to make the Surface Pro a powerful and consistent tool that will build a reputation for future iterations to draw on. Despite it being difficult to assess the long-term payoffs, if Microsoft has succeeded in

improving the design's hardware longevity, it'll be the exact upgrade the line needed.

We weren't thrilled with the high temperatures and throttling of our test model's Core i7 CPU and we're hoping the problem doesn't extend to the Core i5 units, but since the latter ditched the fans altogether, we're expecting they don't. We've requested a Core i5 review unit, so we'll hopefully be able to confirm that in an upcoming issue.

If you're after an ultra-portable Windows device with a stylus, then there's still no better alternative than this. ■ Joel Burgess

Verdict

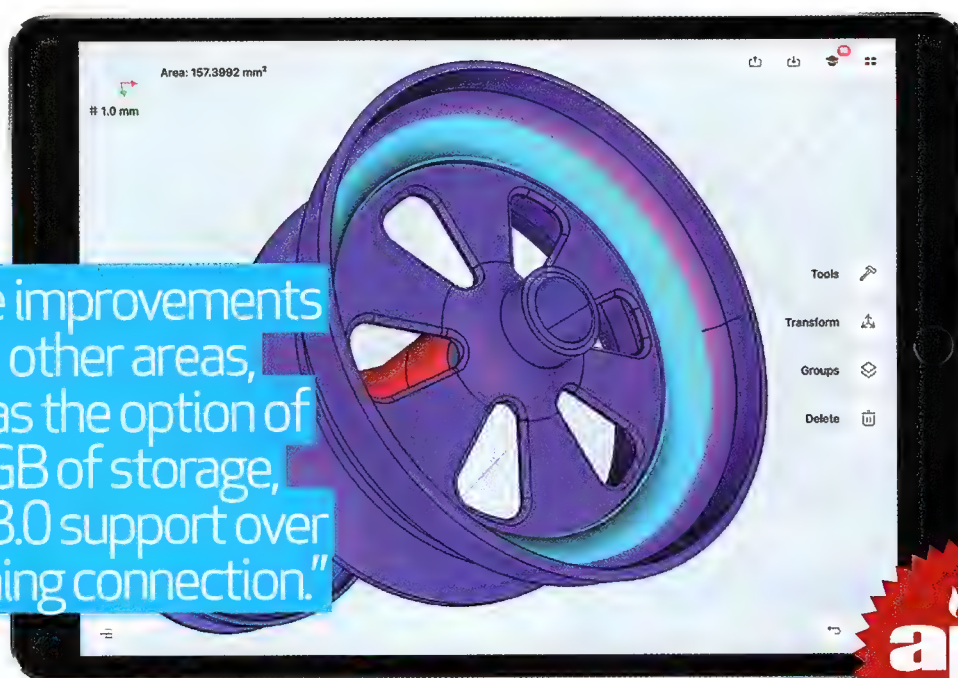
Features
Performance
Value



A powerful Windows tablet that shines in creative versatility and benefits from some important longevity upgrades.



"There are improvements for pros in other areas, too, such as the option of up to 512GB of storage, and USB 3.0 support over the Lightning connection."



TABLET

FROM \$979 (WI-FI, 64GB) | WWW.APPLE.COM/AU

Apple iPad Pro (10.5-inch)

The working tablet age is here.

There's an saying for most new tech: don't buy the first version. No matter how ground-breaking and good it is, the second will be even better. And Apple has improved things in three key areas from the 9.7-inch iPad Pro: the amount of working space, the quality of the display, and the performance. The move to a 10.5-inch screen with a higher resolution of 2,224 x 1,668 adds about 20% more display area, while keeping the same pixel density.

Items on the screen generally stay the same size as they were on the 9.7-inch model, but you have more space to play with, and it allows for extras such as the on-screen keyboard to be about full size. It's subtle overall, but it's instantly obvious if you work in Split View a lot. Before, it was usable but a little cramped on the smaller Pro. Now, we can happily do all kinds of work with our email app locked to the right-hand quarter of the screen.

This screen is a wonderful balance between space and portability.

But the size isn't the only interesting change to the display. One big feature is 120Hz support, which doubles the number of frames per second the screen shows compared to Apple's previous displays. It makes animations look extremely smooth, and scrolling text more readable. The iPad display is powered by ProMotion tech, which doesn't always operate at 120Hz. If you're watching a TV show or reading a book, the screen runs at a lower rate to save power. This is all essentially unnoticeable, and the iPad Pros do have excellent battery life anyway.

The screen's brightness has been amped up, too. Combined with the wide colour gamut, it makes photos look astoundingly vibrant, and helps with viewing in bright light (along with an improved anti-reflective coating). And it's even good enough

to display HDR video, though support for this won't arrive until iOS 11. Regardless, these Pros are still the best screens Apple has made yet.

The new A10X chip is a triple-core chip (up from the dual-core A9X), with 4GB of memory and a new, more powerful graphics unit. Opening and switching between apps is very fast, but it's in intense tests that you best see its power: in Geekbench 4, it scores 81% higher than its predecessor, and 42% higher than the latest generation of 12-inch MacBook. In fact, its score beats most 13-inch MacBook Pro models. To test the processor, we used WinZip to compress a 1.2GB folder of files, and it finished the task in 25.16 seconds – 30% faster than the 39.93 seconds of the 9.7-inch Pro.

Not many iOS apps use this much power now, but it helps future-proof this machine as more and more powerful apps appear.

There are improvements for pros in other areas, too,

such as the option of up to 512GB of storage, and USB 3.0 support over the Lightning connection. The speakers are still great, and while the Smart Connector hasn't changed, it's handy for accessories like the Smart Keyboard.

So should you get it? If you're looking for a portable work machine, absolutely. But if you just want an entertainment tablet, it's very much overkill. But with its gorgeous display, oodles of power and amazing drawing prowess, this can be a laptop replacement for some. In fact, it might just be our favourite computer in years. ■ Matt Bolton

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

A stunning display and powerful future-proofing make this a top mobile working machine.





X299

EXCEED EXPECTATIONS

AORUS GAMING MOTHERBOARDS

LIGHTING



WITH DIGITAL LEDS
Surround Lighting



SUPPORTS DIGITAL LED
& RGBW LED STRIPS



LED Strips Not Included

AUDIO

AMP-UP
Audio

WITH HIGH-END 127dB ESS SABRE 9018K2M
DAC AND 127dB OPA1622 OP-AMP



SABRE
HiFi

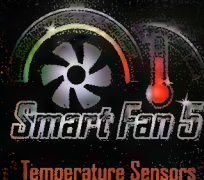


127dB
Rear Panel Audio

4 OP Amps - Clean & clear power with
superior sound quality

SAVITECH Auto
Impedance Sensing

COOLING



Temperature Sensors



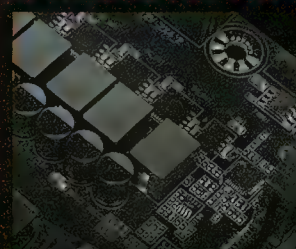
+ FAN
STOP

Hybrid Fan Headers
(Includes support for one
High-Current Pump up to 3 Amps)



PERFORMANCE

SERVER-CLASS DIGITAL POWER DESIGN



TURBO B-CLOCK

Advanced Performance Tuning IC

www.gigabyte.com.au

GIGABYTE™



GAMING LAPTOP

\$3,499 | WWW.JBHIFI.COM.AU

MSI GE72MVR 7RE Apache Pro

A lumbering gaming giant that's a little spryer than you might expect.

For regular APC readers, just looking at the GE72MVR might be enough to evoke a sense of déjà-vu, but this isn't simply because we've covered GE72 models before, but rather, that every aspect of this device looks really similar to most other MSI gaming laptops we've got our hands on over the past couple of years.

Fortunately, this complaint is generally only skin-deep, since there's plenty of powerful components and new technologies under the hood of this latest GE72. The most notable of those is the 17-inch, 120Hz display that features a sub-5ms response rate and a 1080p resolution. The extra screen real-estate of the 17-inch form factor is appreciated, but it definitely adds to the bulk of the 2.9kg unit overall and also seems to significantly reduce the battery life, for which the GE72 scored only 2 hours and 2 minutes in PCMark 8's 'easier' Work battery benchmark.

That big screen is backed up by powerful parts elsewhere, too, with the laptop-gear Intel Core i7-7700HQ CPU and 16GB of DDR4 RAM teaming up to deliver an impressive score of 5,134 in PCMark 8's general work tasks benchmark.

From CineBench's single-core CPU tests you can see that each core of the 7RE's i7-7700HQ CPU offers an individual performance boost of 17% against last year's popular i7-6700HQ (as seen on many a gaming laptop around this price), although when you amalgamate the processing power of the four cores in multi-threaded benchmarks, the overall performance boost drops to a far less-impressive 5.7%. There's not a lot of reason to upgrade here, really.

In addition to a powerful CPU, this 17-inch monster offers Nvidia's GeForce GTX 1070 GPU. With more than enough grunt to drive VR titles, this powerful combo churns through modern

gaming titles on 1080p Ultra settings with average frame rates of 70.1 in Ubisoft's *The Division* benchmark. On older titles like *GRID 2*, *Metro: Last Light*, *Tomb Raider* and *BioShock Infinite*, you're getting average frame rates of more than 70fps using the top 1080p quality settings, though you'll need to drop those a little to reach the higher +100fps framerates that can really reap the benefits of that 120Hz display.

Although you might see the '(optional) PCIe SSD' labels on the packaging and in the product features lists, in Australia, this model is a JB Hi-Fi exclusive and there's only one configuration available at present, so don't be expecting to get ultra-fast storage.

With sequential read and write speeds around the 530MB/s mark, the Samsung 256GB SATA 6Gbps SSD inside isn't exactly slow, but it is a little disappointing it's not the 1,500MB/s+ read/write speeds you commonly

get with a PCIe-connected laptop SSDs.

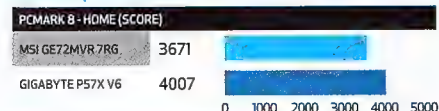
The GE72MVR 7RE comes in at a slightly eye-watering \$3,499, which seems expensive when you look at the competition. You can pick up the identically-specced ASUS ROG GL702VS for \$300 less, or MSI's own GS73 7RF Stealth Pro for \$650 less, although you won't get that 120Hz, 5ms screen.

In other words, you'll have to really love playing games at super fast frame rates to justify the extra outlay for this pricy screen addition. We're willing to admit that, for some gamers, however, that'll be worth the cost.

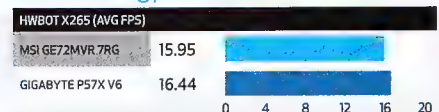
Joel Burgess

LABS BENCHMARK RESULTS

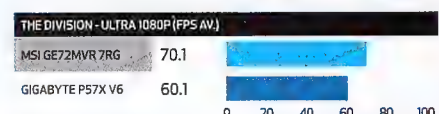
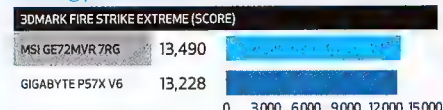
General performance



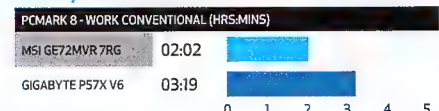
Media encoding performance



Gaming performance



Battery Life



Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

With a speedy 120Hz screen and a good set of gaming components, this will appeal to a niche group.





GAMING LAPTOP

\$2,999 | WWW.ASUS.COM/AU



ASUS RoG Strix GL502VS

A truly portable gaming powerhouse.

We're big fans of 15-inch laptops. They're large enough to give you the screen real estate needed to play games without squinting, but not so large (cough, 17-inchers) that they require a special backpack. They're the form factor that lets a portable gaming machine feel portable.

The RoG Strix GL502VS delivers on portability. Measuring only 3cm thick, it's one of the thinner GTX 1070 laptops we've tested, fitting into a new breed of portable pixel-pushers that don't require massive jet engines to cope with the heat output of mobile graphics chips.

Inside, it features an Intel Core i7-7700HQ CPU, 16GB DDR4 RAM and a GTX 1070 GPU. Where it sets itself apart, aside from the form factor, is in its display. Where most gaming laptops offer a 1080p G-Sync IPS screen, they are mostly held back by panels with a 60Hz refresh rate. The GL502VS

steps things up with a 1080p "IPS-like" matte panel with a 120Hz refresh rate. Frankly, much of the GTX 1070's pixel-pushing power is wasted on a 60Hz screen, as it's more than capable of maintaining frame rates well above 80-100fps at 1080p. With the GL502VS's 120Hz G-Sync screen, you aren't forced to choose between screen tearing and higher than 60fps.

Speaking of frame rates, the GL502VS easily handled everything we threw at it. It scored an average of 103fps across *Rise of the Tomb Raider*'s benchmark, scoring 128fps in the Mountain Pass, 95fps in Syria and 86fps in the Geothermal Valley, all at 1080p max settings. In *Far Cry Primal*, it scored 80fps using the in-game benchmark, and 79fps in *The Division*. Plus, it scored 13,202 in 3DMark Fire Strike. Those numbers destroy our Labs test laptop and are on par with or better than our desktop.

The GL502VS's chassis is a vast improvement over the

larger, more expensive G752VS, the updated version of ASUS's flagship gaming laptop. The GL502VS has a more understated look that maintains a bit of the RoG brand's angular aesthetic, while toning down some of the more aggressive styling. Of course, the G752VS's size mostly comes from its large rear vents, but in our tests, the GL502VS's smaller size didn't limit it thermally in any noticeable way, and it comes in at a much more attractive price point.

For connectivity, the GL502VS has all the usual suspects: three USB 3.0, alongside one USB Type-C, as well as one each of HDMI and Mini DisplayPort for connecting to external monitors. Unfortunately, it's missing Thunderbolt 3 connectivity in the Type-C port, limiting transfers to 10Gb/s instead of Thunderbolt 3's 40Gb/s.

The other main drawback is battery life. With only a 62Whr battery, the power draw of the GTX 1070 means your time untethered is

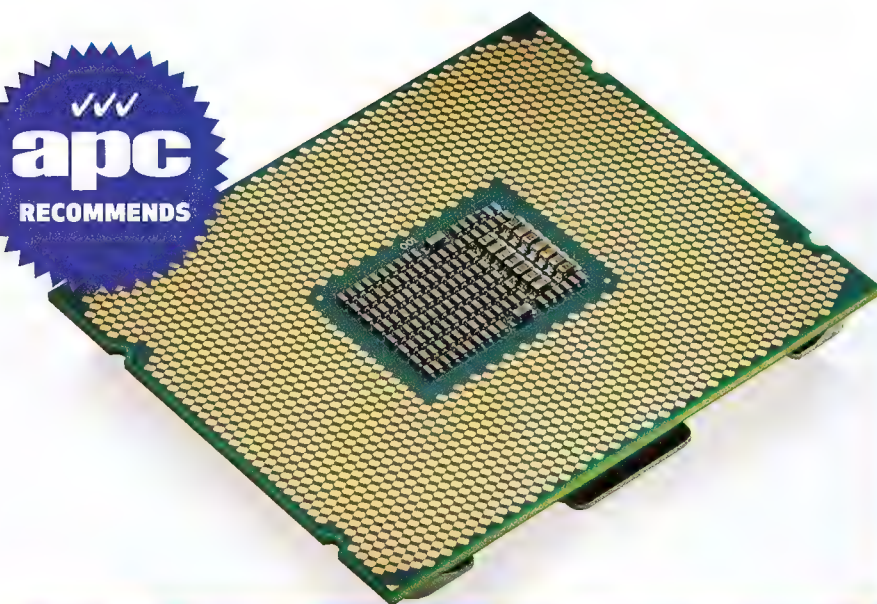
limited to an hour or two, even when not gaming. That said, the low battery life is more than made up for when considering the GL502VS's price. At \$1,699, it's hundreds of dollars cheaper than most GTX 1070 laptops. And while it's not the most portable — especially compared to the ultra-thin Razer Blade (see APC 443, page 18) or the upcoming Nvidia Max-Q laptops — it's small enough for a normal backpack, and not too heavy. Of course, if you insist on more screen real estate, the 17-inch GL702VS is effectively the same laptop in a larger frame. ■ Bo Moore

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

Great performance for the price, with a sweet 120Hz G-Sync display for all your gaming needs, and it's not super-bulky.





INTEL CPU

\$1,450 | INTEL.COM.AU

Intel Core i9-7900X

Ten cores is just the beginning...

Recent years have seen only small, incremental upgrades to Intel's top-drawer enthusiast chips. Out of nowhere, however, Intel announced a whole box full of new CPUs, a new LGA2066 socket to stick 'em in, and a new X299 chipset to underpin the whole shebang.

In one fell swoop, Intel has gone from a maximum of 10 cores for desktop PCs to 18 cores, with additional 'tweener options filling the newly opened chasm between the old and new realities of Intel's high end.

Where the real weirdness comes in is that Intel has announced all those new CPUs, but hasn't been able to provide full specifications. For the 14- to 18-core models, we know the model names and core counts, but that's pretty much it. We don't know clock speeds or TDPs. The reason, almost certainly, is that those chips are a hasty reaction to the announcement from AMD, Intel's only rival in the

performance PC processor market, involving a shocking new 16-core CPU known as Threadripper. From nowhere, Intel is faced with some real competition. Its reaction feels like a loss of composure.

But what of this Core i9-7900X CPU? It's a 10-core chip based on the Skylake-X microarchitecture – likely the CPU Intel had intended to roll out as its top offering for the new X299 platform. That's why it's ready for launch now, and everything above arrives later this year, at the earliest.

Across all 10 cores, the base clock and Turbo speeds are 3.3GHz and 4.3GHz respectively. However, the revised favoured core mode, also known as TurboMax, can crank up the clocks on the two highest performing cores to 4.5GHz. The idea is to ensure that these multicore models deliver the best of both worlds – lots of cores and threads for multithreaded software, and high clocks when performance depends on

one or two really intensive threads. The equivalent clock speeds for the old 10-core Core i7-6950X are 3GHz, 3.5GHz, and 4GHz.

In terms of features, one is the addition of AVX-512 support – previously the preserve of Intel's big-ticket Xeon processors, to which all these new Core chips are, of course, closely related. AVX-512 is part of a long line of floating-point extensions to the x86 instruction set, which date right back to the likes of MMX and SSE. In reality, few, if any, desktop applications currently support AVX-512. But the feature is now available, and that will change over time.

More important, however, are revisions to the cache memory hierarchy. The obvious change amounts to more L2 cache and less L3 cache per core. However, the details involve a shift from inclusive to non-inclusive cache, which means a shake-up in terms of policy, latency and efficiency. In short, it will take time for

the full implications of the changes to the cache to shake out, but some apps will benefit significantly more than others.

The big jump in the all-cores Turbo clock speed certainly contributes to a healthy uptick in performance of around 20% in multithreaded apps, such as Cinebench. Factor in the \$1,450 price tag, where the old 6950X was a \$1,700 chip, and the new 7900X looks very compelling. It's the fastest PC processor yet by some margin – for now. When AMD's Threadripper arrives, that \$1,450 figure won't look nearly so clever.

■ Jeremy Laird



Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★☆☆

The fastest CPU yet includes a great combo of cores and clocks for a big price cut... but wait for Threadripper.





INTEL X299 MOTHERBOARD

\$740 | WWW.ASUS.COM/AU

ASUS Prime X299-Deluxe

Our first look at Intel's new Skylake-X platform.

This is the first time we've had a good look at the X299 chipset. The new all-encompassing HEDT platform from Intel is designed to encapsulate both the low- and high-end desktop parts – everything from four-core, four-thread processors, right up to 18 cores and 36 threads. This new spec opens up more questions than answers, though, and looks to be, at first glance, far less appealing than Intel would want you to believe.

Intel has finally upgraded its direct media interface (connecting the processor to the chipset) to DMI 3.0, swapping out the 4x PCIe 2.0 lanes to 3.0 lanes, doubling bandwidth in the process. This is to cope with the extra bandwidth necessary to cater for the substantial upgrade to the integrated PCIe lanes on the chipset itself, because we've seen a leap up from eight PCIe 2.0 lanes to 24 PCIe 3.0 lanes. This is seemingly a leaf taken from the mainstream

Z270 platform, as its expansive support for multi-GPU and PCIe SSD solutions is one of the few things that differentiates it from the competition. There's a few extra USB ports, too, but that's about it.

There's still no support for USB 3.1 or 10Gb/s Ethernet, and we're still stuck on quad-channel memory (on the processors that support it). Our main issue with X299 all comes down to how many processors this new socket supports. Intel will happily sell you a four-core Core i5 part, with no hyper-threading, dual-channel memory and a measly 16 PCIe 3.0 lanes for no less than \$265. Regardless of how high you can overclock these parts, the notion of paying \$10 more for a processor that's just a migrated Core i5-7600K, sans integrated graphics, is ludicrous, especially when you can't take advantage of that new platform from the get-go. In fact, the cheapest motherboard we've seen is the ASUS TUF X299 Mark 2,

coming in at a staggering \$429. So that's \$790 to start you out in this new HEDT platform, yet without any of the perks associated with it. You could achieve identical performance with an Intel Core i5-7600K and an ASRock Z270M Pro4, for a total of \$518.

Arguably, it does provide a substantial upgrade path if you're planning to purchase a higher-specced processor later down the line. But that's really niche.

The X299-Deluxe is one of the priciest X299 boards available – coming in at a staggering \$740. You get a well-equipped board, featuring three PCIe 3.0 x16 slots, an M.2 heatsink, vertical M.2, U.2 support, six SATA 6Gb/s ports, plus DDR4 support all the way up to 4,000MT/s. The RGB lighting is actually fairly classy and there's a neat little ASUS LiveDash OLED display that shows CPU temperature, frequency, fan speed and UEFI BIOS errors.

Whether the X299 is worth it is hard to say right

now. As usual with any new Intel process, we're witness to a 10-20% increase in performance, and that's about it. Skylake X feels lackluster in contrast to its predecessors, and even to Ryzen. We should see some interesting competition once those 12-core and above parts reach the consumer ecosphere, but until that happens, there's very little reason to upgrade over the X99 platform.

With AMD's EPYC-based Threadripper 16-core parts just around the corner, we're starting to wonder whether Intel might have lost the plot on this one.

■ Zak Storey

Verdict

Features
Performance
Value



While it's a stunning mobo, well equipped, with an upgraded onboard PCIe chipset and nice RGB, that price...





AMD CPU

\$245 | WWW.AMD.COM

AMD Ryzen 5 1400

Give it up for AMD's budget Intel-killer.

With the fallout from Computex still in the air, it's easy to

lose sight of the less spectacular versions of the chip that started this new influx of processors. We speak of AMD's Ryzen – in particular, the Ryzen 5 1400. Currently, it's the lowliest Ryzen of all, but considered in context, it's also the most relevant.

It delivers four proper CPU cores and support for eight software threads at a significantly lower price than Intel. The 1400 clocks in at \$245. The cheapest quad-core Intel chip, the Core i5-7400, doesn't look too distant at \$265, but it only packs four threads. If you want eight threads from Intel, it's a huge leap up to the \$470 Core i7-7700.

One can debate the value of the simultaneous multithreading tech that allows a CPU core to process more than one thread in parallel, but let's not get ahead of ourselves. Along with those four cores and

eight threads, the Ryzen 5 1400 weighs in with a 3.2GHz base clock and a 3.4 maximum Turbo speed. Like its quad-core sibling, it's rated at 65W, and slots into AMD's new AM4 mainstream CPU socket.

It also packs a total of 384KB of L1 cache and 2MB of L2 cache. Again, that's a dead heat with the 1500X. Where things differ is with L3 cache. The 1400 sports just 8MB to the 1500X's 16MB. That's intriguing, not simply because the 1500X has double the cache – more cache normally means more performance – but also because of what it may indicate about the internal structure of the two chips.

The Ryzen CPU die is composed of two quad-core complexes, each with 8MB of L3 cache. So you might think the L3 cache count indicates the 1500X operates in a 2+2 config with both complexes enabled, but each with just two cores switched on, while the 1400 runs a single-core complex, with all four cores firing.

For now, it appears that isn't the case. The 1400 runs the same 2+2 configuration, just with some of the L3 cache fused off in each complex. However, AMD isn't being hugely forthcoming, so it wouldn't surprise us if it turned out that it was taking both approaches in order to use as many dies as possible.

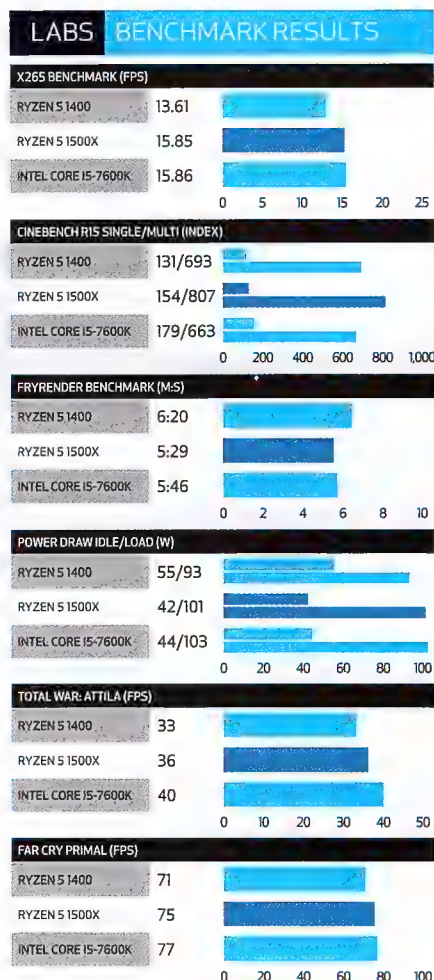
Ultimately, all that matters is performance, and the news here is mostly very good. The 1400 delivers the kind of numbers you'd expect on the whole, based on core and thread count, and clock speed.

This means that, in the most scalable workloads, such as Cinebench, it has the edge over much more expensive quad-core, quad-thread chips, such as the Core i5-7600K, but falls a little short when it comes to software that lean a little more heavily on individual core performance. Like every Ryzen CPU thus far, the 1400 is also fully unlocked, and comfortably achieves 4GHz with the

most rudimentary of tweaks, at which speed, it's overtaken the 1500X model running at stock clocks, closed some of the single-thread gap to the Core i5, and positively obliterated the latter for outright multithreading throughput.

All this makes the 1400 a pretty compelling package. However, the lower down the Ryzen range you go, the more tightly things are packed. Moreover, given you're going to need a new motherboard, and probably some memory, too, an extra \$45 for the cheapest six-core Ryzen looks like an awfully good deal.

■ Jeremy Laird

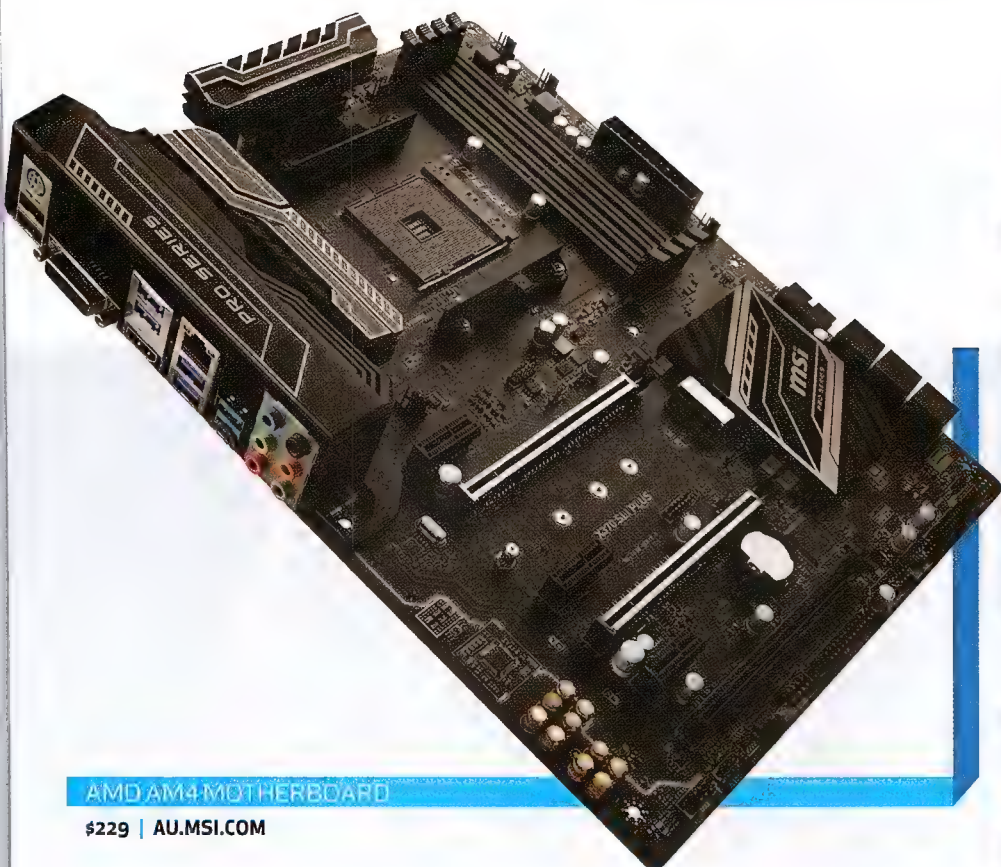


Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

This Ryzen offers lots of cores and threads for the money, plus decent overclocking potential.





AMD AM4 MOTHERBOARD

\$229 | AU.MSI.COM

MSI X370 SLI Plus

MSI's back in black, but is it poised to attack?

Unlike similarly priced and positioned offerings from the competition, the sleek design queues of MSI's X370 SLI Plus makes for an AMD 'board that demands interest through intrigue, rather than shouting.

This intrigue runs through to the component selection and feature implementation. Scrutinise the specs and some unexpected choices emerge. For example, the six SATA 6Gbps ports seem like an odd selection, given X370 boards typically sport eight. Furthermore, the use of a Realtek 8111H NIC for LAN is usually found on an entry-level B350-based 'board, with Intel I211-AT or I219V used for these higher-end X370 deployments. This spec switch extends to the audio codec, too, with the X370 SLI Plus using the Realtek ALC892 instead of the Realtek ALC1220 found on most other X370 'boards.

Essentially, when it comes to specs, the X370 SLI Plus

feels like a cross between MSI's B350 Tomahawk and its X370 Gaming Pro Carbon, on both spec and price positioning.

The SLI Plus was largely on par with other X370 motherboards we've reviewed – that is: great across multi-core intensive tasks like video encoding and 3D rendering, and generally able to match Intel's far more expensive Broadwell-E/X99 gear at higher-resolution gaming.

Our 1080p gaming test results were still, however, a little lower than Intel's, although just as we went to print, AMD released a patch that was intended to correct this shortcoming, so we'll revisit this soon. (Regardless, Ryzen is still going to be an expensive platform if you're just aiming for 1080p gaming.)

We hit a few hiccups in testing, however. An unexpected crash occurred while running PCMark, and again during a 3DMark run. Though we did ultimately manage multiple successful

benchmark passes, the crash outlier is still not an expected or wanted experience. Unfortunately, a much more significant performance issue occurred while testing *Far Cry Primal*, a title proven to be sensitive to memory. Regardless of the massaging of different system voltages to eke out stability for our test settings, we simply couldn't get a crash-free run of *Far Cry Primal*.

Visually, the SLI Plus is dressed in a sleek all-black component selection with silver-chrome accents, which the designers have used to create line work that breaks up areas that might otherwise appear chunky, such as the rear I/O cover and heatsink for VRM and PCH.

Perhaps a missed opportunity during the design phase, the motherboard features minimal LED illumination qualifications. With RGB LEDs restricted to the rear-lit LED lighting of the PCB gap for the audio solution

and a single RGB header for LED strips, we can't help but feel this could have been beefed up more, especially given the overall subdued colour scheme of the motherboard.

Putting aside the issues we experienced with *Far Cry Primal* and a couple of random crashes, the MSI X370 SLI Plus was a delight to use. And compared to pre-launch and early launch X370 setups, it was a breeze, but ultimately... there's just nothing particularly headline-worthy about this board, making it a bit of an 'also-ran' that's hard to recommend.

Josh Collins

LABS BENCHMARK RESULTS

PCMARK 8 - HOME (ACCELERATED)

MSI X370 SLI PLUS	5,064
ASUS ROG CROSSHAIR VI HERO	15,026

HWBOT X265 BENCHMARK 1080P/4K (AVG FPS)

MSI X370 SLI PLUS	30.05/5.51
ASUS ROG CROSSHAIR VI HERO	30.07/5.50

CINEBENCH R15 - CPU (MULTI-THREADED)

MSI X370 SLI PLUS	1642
ASUS ROG CROSSHAIR VI HERO	1633

CRYSTALDISKMARK 5 SEQUENTIAL READ/WRITE (Q32T1)

MSI X370 SLI PLUS	3,403/1,924
ASUS ROG CROSSHAIR VI HERO	3,400/1,926

3DMARK (2013) - FIRE STRIKE EXTREME

MSI X370 SLI PLUS	6015
ASUS ROG CROSSHAIR VI HERO	6114

FAR CRY PRIMAL (1080P, AVG FPS)

MSI X370 SLI PLUS	DNF
ASUS ROG CROSSHAIR VI HERO	79

Verdict

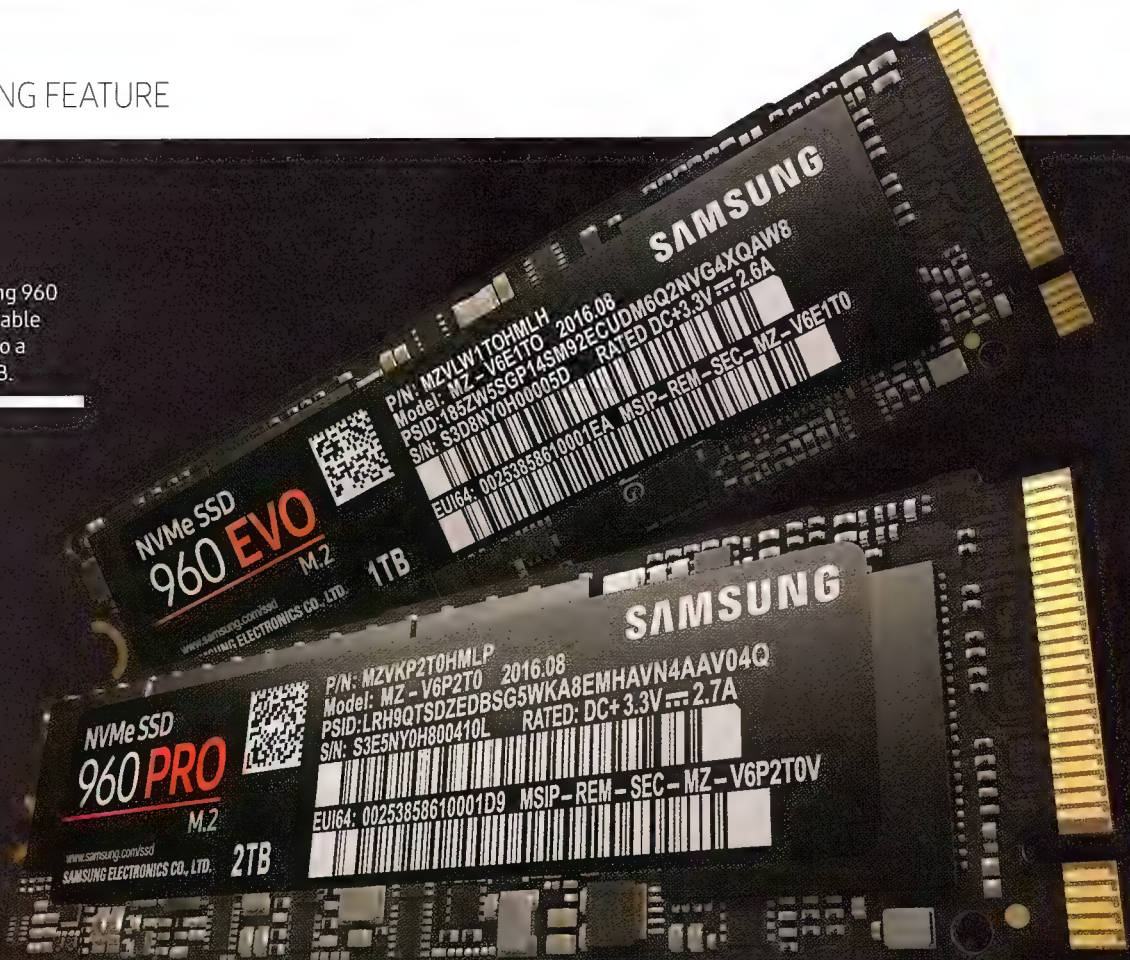
Features
Performance
Value



A beautifully subdued board, but we have some concerns around the overall user experience.



The Samsung 960 PRO is available in sizes up to a massive 2TB.



WHY YOU NEED AN NVMe SSD

For PC enthusiasts chasing the ultimate in performance, the latest Samsung NVMe SSDs are incredible. But are they worth the price tag?

SSDs go next-gen

Solid-state storage drives have been on the market for a long time now, but their performance (while excellent) may have been constrained by the need to support older hardware and storage interfaces. But in the last 18 months, we've finally reached the tipping point — and next-gen NVMe SSDs are now taking off. But is it really worth the upgrade to one? To backtrack for a minute, even early SSDs had no trouble maxing out the bandwidth available to SATA connections, a standard that

was really designed for use with slower mechanical drives. Even moving on to new interfaces such as PCIe, the fastest SSDs were hamstrung by the AHCI command protocol, which, while fine for slower speeds, wasn't efficient enough for the kind of cutting-edge performance we're now seeing. So a new protocol, NVMe, was developed to handle SSDs, which combined with a PCIe interface, gives us NVMe. The result is a system that was designed to specifically handle the parallel,

low-latency nature of SSDs. That's important, because not only does it give amazing performance, but it's ready for fast drives in the future.

NVMe benefits

NVMe SSDs have incredible performance, but how will that extra performance actually help in the real world? While the difference may not be as noticeable as upgrading from a mechanical hard disk to an SSD, super-fast NVMe drives give super fast boot



The Samsung 960 Evo is designed to be fast yet affordable, with excellent bang for buck.

times and an all-round responsive experience across your apps. It's worth noting, of course, that an NVMe drive needs a compatible motherboard — though most new models are NVMe ready. Even so, the rest of the PC needs to be suitably outfitted to handle the extra performance. For a machine with a slower CPU or GPU, data access times won't actually be the slow point and even the fastest NVMe SSD won't remove the bottleneck.

A sleek form factor

Users chasing performance goals will probably be familiar with running an array of SATA SSDs, or using PCIe interface drives or M.2 expansion cards. In comparison, NVMe drives almost all use the M.2 form factor and can be mounted directly to the motherboard, giving high speeds without taking up extra space. This makes it easy to build a custom mini gaming PC, a low-profile media PC, or even get sensational gaming or media performance from a compatible laptop. Many boards have dual

M.2 slots, allowing for future upgrades, or NVMe SSDs running in RAID.

Gaming in a flash

Having an ultra-fast SSD does help improve gaming performance, but unless your PC has some weird bottlenecks, actual frame rates will only see a small boost. Importantly, though, load times can be reduced. One frustration for gamers can be running out of space on their primary drive — but with SSDs such as the Samsung 960 Pro available in up to 2TB capacities, it's possible to have a huge library of games.

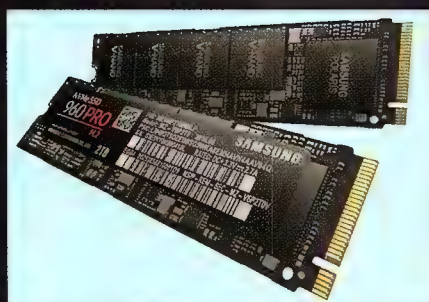
Pro and media users

For those who deal with large media files, such as 4K video editing, the low latency and high read and write speeds of NVMe SSDs can really help boost performance. Software will load fast, open files quickly and generally feel a lot snappier. Exporting or copying large media files will also be quick, and the protocol overhead of NVMe is designed to reduce the load on your CPU, letting it get through

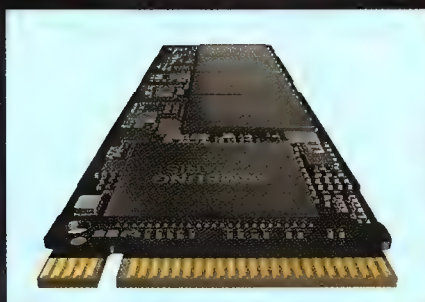
other tasks faster. The Samsung 960 Pro also has excellent endurance, so it's ideal for users who read and write a lot of data.

SSD choice

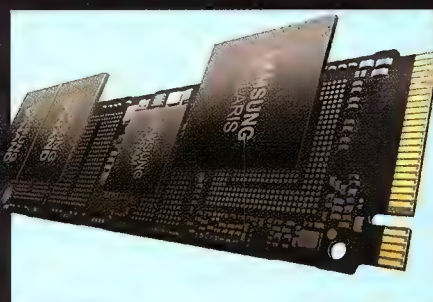
Here in Australia, there's a large range of NVMe SSDs available, but for anyone who's after exceptional performance, Samsung's 960 Pro is the undisputed Samsung king, with sustained read speeds of up to 3,500MB/s. The drive is available in 512GB, 1TB and a massive 2TB capacity. It's also backed by a 5-year limited warranty, with a large 1,200 TBW rating. For those after something fast, but at a slightly friendlier price, the Samsung 960 Evo tops out at 3,200MB/s, is available in 250GB, 500GB and 1TB capacities. Of course, that's not to say other NVMe SSDs don't have value — but if you're after the ultimate in NVMe solid state performance, Samsung's 960 series drives are highly recommended.



The Samsung 960 Pro offers powerful NVMe SSD performance.



Most NVMe SSDs use the slim M.2 form factor, which helps make it easy to build compact gaming and media PCs.

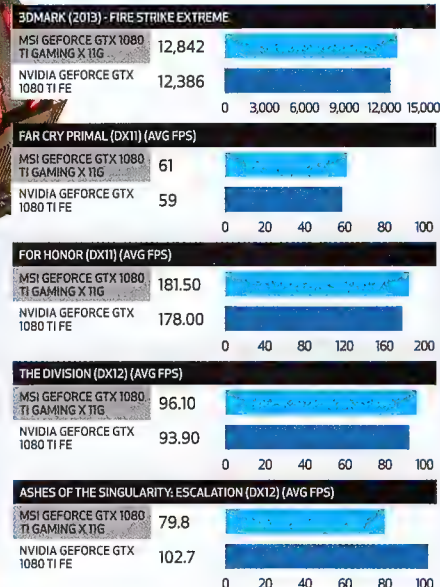


The Samsung 960 Pro uses the NVMe protocol, which enables read speeds of up to 3,500MB/s.



LABS BENCHMARK RESULTS

Gaming performance



GRAPHICS CARD

\$1,199 | AU.MSI.COM

MSI GeForce GTX 1080 Ti Gaming X 11G

It's a graphics card for gaming. Didn't you see the red/black design?

If the red-and-black colour motif wasn't enough of a giveaway for what the target market is, let us be clear: the MSI GeForce GTX 1080 Ti Gaming X 11G is pitched squarely at the PC gaming market.

That red/black aesthetic is feeling a bit dated, though, to be honest, and here, it's doing MSI a bit of a disservice: the card has the now-ubiquitous RGB LED integration, but for that to really shine, it's imperative that the host component utilises a neutral colour. But the red is visually harsh and overly prominent. If overall build aesthetics are important to you, this could very well be a deal-breaker.

The performance of the GTX 1080 Ti Gaming X 11G is as you'd expect – great. With Nvidia's newest top-tier GTX 1080 Ti GPU at its heart, the engine of this pixel-pushing beauty is not only capable of pumping out the eye candy,

but does so without needing a personalised power station next door. This is due to Nvidia's Pascal micro-architecture, helping facilitate the Zero Frozr feature achieved by the Twin Frozr VI. For those who didn't catch the meaning within that marketing speak, 'Twin Frozr VI' is the name of the heatsink/fan implementation used on this card, and many other units in the current generation MSI Gaming line-up. Zero Frozr is a heatsink feature that shuts down the fans during idle and light workloads to deliver a silent, passive cooling solution. This kind of feature isn't new, but MSI's tech is now quite refined, as you'd expect at this fourth-gen stage. As such, we experienced no unnecessary fan ramping or resultant audible airflow gushes during testing and can happily give the unit the tick of approval for quiet computing enthusiasts.

Even under heavy loads, the unit maintained a reasonable aural presence – we've gotta tip our hats to MSI's engineers.

Alongside the card itself, buyers also get the imaginatively named 'MSI Gaming App' software suite. This allows access to numerous GPU-oriented features, the most important of which to gaming are the selectable performance profiles. The card has three profiles worked into the vBIOS (Silent, Gaming and OC) which are selectable with a simple click of a button in the Gaming App. The Silent profile delivers equivalent frequencies to the Nvidia Founder's Edition cards, but with an improved fan profile due to the increased thermal capacity of the Twin Frozr VI heatsink. The Gaming profile – which is on by default and what we used during benchmarking – uses an overclocked core frequency

(1657MHz Boost Clock) with the same memory frequency as the Silent profile. Rounding out the trio is the OC profile which delivers a further overclocked core (1683MHz Boost Clock) and applies a small overclock to the RAM, from 11,016MHz to 11,124MHz.

Though the aesthetics may grind the gears of some, the Gaming X 11G is far from an ugly design. Overall, this is a capable and aurally unassuming top-tier gaming GPU that's well worth consideration.

Josh Collins

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

A very capable GPU core backed by high-quality heatsink design and supporting software.



"The Inspiron 24 7000 is striking. The 23.8-inch Full HD display catches the eye from the minute you open the box, offering a true widescreen experience – although there are some seriously large bezels here."



ALL-IN-ONE PC

\$1,899 | WWW.DELL.COM/AU

Dell Inspiron 24 7000

A solid all-in-one PC for your home or workplace with some surprising plus points.

The Inspiron 24 7000 is Dell's attempt to challenge the likes of the Microsoft Surface Studio and Apple's premium iMacs in the growing all-in-one PC market, which combines everything you'd want in a PC into a single model.

This machine is striking. The 23.8-inch Full HD display catches the eye from the minute you open the box, offering a true widescreen experience – although there are some seriously large bezels here. The PC is also super thin, at just 27mm, and thanks to its movable hinge, the display can be tilted right down to lying flat on its back. This flexibility means that the display isn't able to rise up too high, however, meaning you might need to invest in a screen stand.

All the main components are contained within the base of the display, which packs in the hardware, as well as a surprisingly powerful speaker. With its

metal and black plastic design, it's hardly the most attractive unit, but the angle of the screen means that you won't really notice it in use.

The base model, on test here, offers a decent set of specs, including a quad-core Intel Core i5-6300HQ (Skylake) processor with 6MB cache, integrated Intel HD graphics and 12GB of 2,133MHz DDR4 RAM. Other goodies include a 1TB 5,400rpm hard drive, plus 802.11ac Wi-Fi and Bluetooth 4.0 wireless connectivity. As far as wired connections go, it comes equipped with four USB 2.0 and two USB 3.0 ports, plus Ethernet and HDMI, as well as a memory card reader. Inside, there's Windows 10 Home, making it ideal for home and office working.

These specs put the Inspiron 24 7000 a little behind the lowest-priced iMac offerings, although the equivalent Apple device – the 27-inch iMac with Retina 5K display – will set you back \$2,699, far more than

the Dell. As for Microsoft's Surface Studio, the equivalent model – equipped with similar hardware to the Dell – costs \$4,699, meaning that if you're strapped for cash, Dell's much cheaper device could be everything you're looking for.

The Inspiron offers fairly decent power, given its price range, and was able to take on some of its more powerful competitors, outscoring the Surface Studio in our GeekBench tests – 3,809 on the single core test; 10,649 on the Multi Core test and a decent 16,588 on the Compute OpenCL test.

The version we used came with an Intel Core i5-6300HQ processor, but the device is also available with a more powerful Intel Core i7. This boosted version also comes with embedded Nvidia graphics, instead of Intel hardware, 16GB of RAM, plus a 32GB SSD as well as HDD storage. The standard edition is more than enough to handle the vast majority of everyday work tasks.

Dell is obviously targeting the creative industries; however, this is by no means a portable device, with the unit weighing a hefty 9.46kg. But with its 24-inch display, the Dell Inspiron 24 7000 is a valuable addition to any home or office, provided you have the room for it in your workspace.

Although it lacks the high street appeal of Surface Studio, or the sophistication and build quality of an iMac, for the price on offer, the Dell is a good all-rounder.

Featuring a great blend of value, power and usability, Dell has made solid progress with its all-in-one PCs. ■

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

The Dell Inspiron 24 7000 offers both flexible design and solid hardware. A good budget buy.





GAMING MONITOR

\$1,099 | WWW.AOCMONITORAP.COM/AU

AOC Agon AG271UG

AOC's latest premium gaming panel packs 4K into 27-inches.

We live in an age when tablet computers with high-DPI IPS screens are handed out in boxes of Corn Flakes (other corn-based cereals are available). Well, almost. Similarly, you're nobody in the smartphone game without a decent high-DPI IPS panel at the very least. To be really competitive, you're talking OLED technology.

Yet the one device that could both most benefit from and make the best use of such displays lags miles off the pace, wheezing along as other devices dip over the horizon. Yes, we speak of the PC monitor. That's not to say that the market has been stagnant. Far from it, what with the arrival of adaptive sync, HDR and super-wide aspect ratios. Resolutions and panel sizes are up, too.

But true high-DPI? Not so much. At least, not at a price most of us can afford. So it's hardly surprising to find that AOC's latest premium panel, the Agon AG271UG,

clocks in at over a grand. It's a 27-inch model, with IPS tech and a healthy 4K pixel grid. That makes for a relatively high 168 pixels per inch for a PC monitor. By the standards of phones and tablets, which generally don't get out of bed for less than 250ppi, it's still pitiful. Likewise, it's hard to understand why this panel costs more than twice the price of a TN 4K monitor of the same size.

Remember also that AOC trades on value. A similar monitor from ASUS or Acer would be even more expensive. If it sounds like we're harshing on AOC, far from it. As this type of panel goes, the AG271UG has a lot going for it. It sports lovely, vibrant yet natural colours. It delivers well in our test images, too, rendering white and black scales with little visible compression. Super-smooth gradient rendering is on the menu, too. Pixel response is subjectively nice and zippy, to boot, especially for an IPS panel. Even better, all this is achieved

with none of that nasty inverse ghosting stuff that's a consequence of aggressive pixel overdrive settings.

Black levels and contrast are good, though not quite a match for the best VA panels. There's little evidence of IPS glow, either, which is welcome. It must also be said that, by the standards of PC monitors, the 3,840 x 2,160 pixel resolution makes for very sharp image quality and nice font rendering. What you don't get is that super-smoothness that comes with a DPI so high that individual pixels virtually disappear.

You also don't get a truly high-quality stand and enclosure. Superficially, it checks all the right boxes: There's full adjustability, including height, swivel, rotate and tilt, the bezel is thin and the stand is made of metal. But the design is dated, and the whole ensemble is awkward to assemble. At this high price, you'd expect a slick clip-in arrangement for attaching the stand to the chassis, not

a quartet of cheapo screws. The external, rather than integrated, power supply is also worth a demerit or two.

Of course, high-DPI tech implemented on the PC remains a mixed bag. Driving high resolutions in games is problematic, and the 4K res more or less dictates the AG271UG's 60Hz refresh.

When you can buy a 40-inch 4K TV, capable of 60Hz refresh, for half the price of this, the value proposition seems marginal. It's a nice screen, this AOC, but like pretty much all of its direct competition, it feels a little overpriced for what you're getting. ■ Jeremy Laird

Verdict

Features
Performance
Value



Lovely 4K IPS panel, 27-inch proportions make for pin-sharp pixels, but it could be a little cheaper.





USB MONITOR

AU PRICE TBC (US\$249) | WWW.ASUS.COM/AU

ASUS ZenScreen MB16AC

Extend your mobile workspace.

Portable USB-connected displays aren't anything new. However, ASUS's latest model sports an 800:1 contrast ratio, an IPS panel and a USB-C port. A USB-A adapter is also bundled for older computers. The single cable carries video and power.

A dedicated display like this is a great way to get a second screen where you wouldn't otherwise be able to — like on a laptop. Its 16:9 ratio feels quite natural, plus you don't have to install any software — both Windows and Mac computers should just recognise it as a DisplayPort-connected screen straight away, meaning you can get to using that second monitor quickly and easily.

The 15.6-inch size and 1080p resolution are comfortable, even though the ZenScreen is clearly not in the same league as a high-end LCD monitor.

The IPS panel is also less capable where colour

rendition is concerned; a side-by-side comparison of WebKit's wide colour gamut demo (bit.ly/2qVRuUv) reveals the subtle red-on-red pattern that was clearly evident on our test MacBook's Retina display to be sadly invisible on the ZenScreen.

There's a power button at the bottom right of the display, and two more buttons at the bottom left for navigating menus. The more advanced controls include a four-level blue light filter that adjusts the colour output and eight presets for specific tasks, including game, reading and theatre modes. If those modes don't address a task you perform, you can save up to four customised personal profiles to get them just right for your needs.

Another interesting addition to this screen is the corner hole. This has been designed so that you can place a strong metal pen through this hole, enabling the screen to be propped up and used in portrait orientation. The jury is out, at present, as to whether this is a better method of achieving portrait orientation over something like a flip-out leg. The protruding cable, when used in portrait mode, is rather unsightly, however, and could prove a deal-breaker if you're particularly anal about cable management.

It also comes with a foldable case that not only protects the screen but can also prop it up to a different angle for landscape use.

Sadly, the auto-rotation feature doesn't work with

macOS, but works smoothly with most other Windows laptops.

At the end of the day, this is an affordable way to extend your workspace when you're away from your home or office, with picture quality that's good for general tasks, but less so for pro visual work.

■ Alan Stonebridge

"A dedicated display like this a great way to get a second screen where you wouldn't otherwise be able to — like on a laptop."

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

It's a niche device, for sure, but if you want a second screen you can use anywhere this one works adequately.





GRAPHICS TABLET

\$299 | BUYWACOM.COM.AU

Wacom Intuos 3D

The graphics tablet giant introduces an interesting new format.

When it comes to Wacom products, you expect a high-end feel. Unfortunately, the Intuos 3D doesn't quite live up to other members of the family. It looks great, with pleasing shapes, thin enough to be comfortable and with some useful buttons, but the plastics used in its construction are hard and brittle feeling, rather than the more commonly used soft-touch materials Wacom is known for. Everything feels a little cheap, including the stylus and tablet buttons.

However, the interactions with the tablet are very positive and feel good in extended use; that's important, as this kind of tool often supersedes the use of a mouse. The button clicks feel responsive and inspire confidence on both tablet and stylus. Plus, the buttons are programmed out of the box (with ZBrush Core commands), making for less time spent hunting in menus, keeping you

creative and efficient. Although, this will be of particular interest to ZBrush newcomers, it's a handy default for anybody, saving on setup time when you first install the device.

If you travel a lot, you'll be glad to know that the stylus can be stored in a handy fabric loop at the top of the tablet, and the USB cable can be detached, unlike some other graphics tablets. There is also an option for a wireless kit, similar to other Wacom devices, with a small dongle that plugs in nice and unobtrusively. For a little added protection on the move, Wacom also offers fitted cases for its tablets on its online store.

The most important element of using a device like this is how the nib feels on the tablet's active surface, and you might expect this to match the hard, brittle feeling elsewhere, but the reality is that it's a pleasant experience. If the stylus had the soft rubber grips of other Wacom styluses,

this would be a real joy. As it is, drawing and sculpting only feels 'good'. The nib runs smoothly over the surface and is also replaceable, although not with the variety of nib types that the Intuos Pro offers.

You may appreciate the grid of dots on the tablet's active area, but they could prove to be a distraction to some – equally, others may forget about them altogether. Either way, they don't interfere with the operation at all, so you shouldn't be overly concerned about them.

A big benefit of the Intuos 3D is that it's essentially a bundle to get you up and running with 3D sculpting as easily as possible. The box comes with a download code for the powerful ZBrushCore from Pixologic – a well-regarded 3D sculpting and painting app, priced at US\$149.95 (about \$200).

What's more, included with the bundle is time-limited access to ZBrush training videos, which will

be useful to newcomers who want to explore the possibilities of working in 3D.

The overall experience with the Intuos 3D is a good one. The bundle offers fantastic value, but it's worth taking a moment to look at the tablet on its own. The materials don't replicate the premium feel we're used to from Wacom, but you soon forget that, and working with it is a lot of fun. We find that using a tablet for artwork is more intuitive, precise, healthy and fun than a mouse and keyboard, so the Intuos 3D should be considered if you're on the hunt for a new input device.

Verdict

Features
Performance
Value



The quality of the user experience makes up for any disappointment in the cheap-feeling plastics used here.





TABLET KEYBOARD

\$249 | WWW.BRYDGEKEYBOARDS.COM

Brydge 12.3

Building a bridge to a Surface Pro laptop.

Microsoft's exceptionally well-crafted Surface Pros are hard to beat when it comes to Windows 2-in-1s, and although its unique tablet-first form-factor and kickstand support-mechanism offer some interesting benefits over the traditional laptop design, there's always the nagging concern that it's difficult to use on your lap.

With an identical surface area and weighing roughly the same as a Surface Pro, the Brydge is a Bluetooth keyboard that's intended to transform Microsoft's slate into a clamshell laptop. The consequence of engineering a keyboard base that's able to hold an 800g tablet upright is that the whole package ends up being rather weighty — combined, adding up to more than most ultrabooks at 1.5kg.

The Brydge's clever protruding hinges and secure rubber fittings do hold the tablet securely, though, while giving the

keyboard a nice incline and allow balanced viewing angles up to 160°.

The keys offer a more generous travel distance than the thin membrane ones on the Surface Keyboard Cover, and provide a comfortable typing experience overall. The Brydge 12.3's trackpad is, however, a little on the small side, but it's compatible with Microsoft's multi-finger swipe actions that are a massive perk for any MacBook-familiar power users. The Bluetooth connection was consistent in our testing, and the rechargeable three-month battery life is also super convenient.

At \$249, the Brydge 12.3 brings a lot to the table.

■ Joel Burgess

Verdict

Although a little heavy, it offers perfect laptop functionality and a gesture-capable trackpad.



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GAMING MOUSE

\$79 | WWW.HYPERXGAMING.COM

HyperX PulseFire FPS

Is HyperX's first mouse more than just a piece for the completionist?

Upon first inspection, you'd be forgiven for mistaking the PulseFire for a rebranded Razer DeathAdder Chroma with its right-handed design, no-fuss simplicity of its features, elegant curves and matte black aesthetics.

The PulseFire's focus is on durability, utility and value rather than over-the-top customisation or replicating the button-swamps of more expensive alternatives. That said, this mouse does have one significant leg-up over its Chroma competition in the form of a dedicated DPI button, a feature only found on Razer's higher-end DeathAdder Elite, which costs around \$15 more. This button cycles through its four preset settings, from 400 to 3,200dpi and changes the lighting colours to let you know which is which.

The construction of the PulseFire FPS feels solid, with durable Omron switches under the main buttons that are satisfying

and responsive, a lovely braided cable and a suitably clingy textured grip.

Despite this overall sturdiness and heft, the mouse is still lightweight at 95g. Given its elongated shape, the form is more suitably molded for a palm grip and is exclusively for right-handers.

Given that the PulseFire comes in at \$79, this puts it halfway between Razer's DeathAdder Chroma (\$65) and the DeathAdder Elite (\$95), making it excellent value if you need that DPI-switching capability, but the lack of software, custom lighting and a slightly less flexible sensor make it tough to outright recommend over the cheaper Chroma.

■ Harry Domanski

Verdict

While stylish in design, light and solid, for the price, there are other, better options out there.



GAMING HEADPHONES

\$169 | STEELSERIES.COM

apc
RECOMMENDS

SteelSeries Arctis 5

Nice design, sound and mic... shame about the feels.

This reviewer is on a quest to find a gaming headset that sounds great, doesn't overheat her head, doesn't cost the sun and stars, and actually fits her more-compact dome.

The Arctis 5's design is quite pleasing – simple, yet with enough flair to hold the attention. The elasticated suspension headband comes in a variety of fabric colours with an intricate geometric pattern. However, while this band can be adjusted, your reviewer's little head has again fallen outside the designers' user spectrum.

While the AirWeave ear cushions are pleasantly soft, they don't provide quite the required depth to stop your ears from touching the thin layer of fabric that covers the hard-plastic drivers. And after extended periods of use, that pressure can result in sore ears. However, other head sizes may differ.

The 'phones do have a great retractable mic which includes a mute button, and a volume control slider

wheel (both on the left can), but no play/pause and next buttons. It also come with an in-line 'ChatMix dial', which allows you to tweak the balance of mic audio to game sound on the fly.

So how did they sound? Pretty great, actually. After we tweaked the preferences in the SteelSeries Engine 3 software, we found the balance to be just right while playing music and gaming. They apparently use the same 40mm speaker drivers that SteelSeries has put in their flagship \$300 headsets, so it's no surprise they sound so good. The 7.1-channel surround sound means you hear gunshots from all directions while in-game, enhancing the experience quite well.

■ Carmel Sealey

Verdict

Unfortunately, this writer's quest continues, but otherwise, these are a nice pair of cans.



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software

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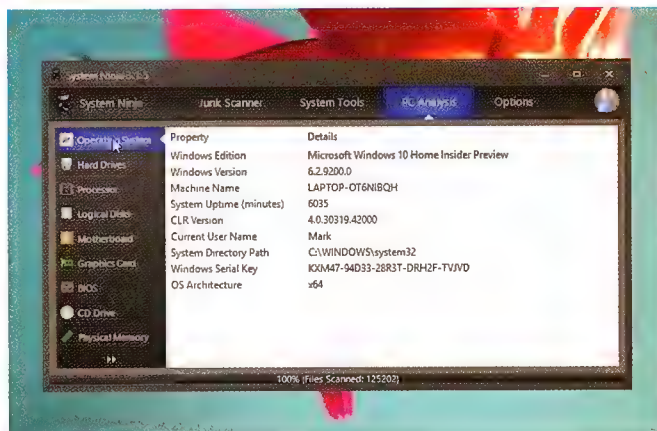
System Ninja is kind of an all-in-one PC maintenance toolkit that aims to provide you a quick and easy way to optimise your PC. If you're running low on disk space, it can help you to recover valuable megabytes (or even gigabytes) while improving your privacy and security.

On top of this, you'll find an uninstaller for quickly removing programs you no longer need, a startup manager to cut boot time, and a process manager for keeping an eye on what's running in the background. There's also the PC Analysis section, which tells you everything you could ever need to know about your hardware.

System Ninja has a simple tabbed interface that suggests (but doesn't enforce) a particular workflow: start at the left with the Junk Scanner and work across to the right.

System Ninja's Junk Scanner serves a dual purpose. It removes unnecessary programs and unwanted files. Leftover files and cookies are a potential privacy and security risk, so it's good practice to clean up after messy programs.

The System Tools tab contains the Startup Manager, App Uninstaller and Process Manager. In many ways, these all mimic features and options already available in the various versions of Windows, so the real benefit here is that they're all accessible in the same place.



The PC Analysis section is very neatly laid out, and is a veritable goldmine of information for anyone curious about their hardware. If you want to find out the model of your motherboard to check how much RAM it supports, check the exact model of your graphics card to make sure you download the right drivers, this is where to look.

It's not perfect, though. While useful, System Ninja's Startup Manager has the potential to be a little dangerous for one simple reason — there is just not enough information given about startup items for many people to be able to correctly identify what they are and to determine whether they're essential.

Even if you feel that System Ninja doesn't have a great deal to offer that can't already be found in Windows, the fact that it's free and provides a handy single interface to access a wealth of tools still makes this one useful to have on hand.

Mark Wilson

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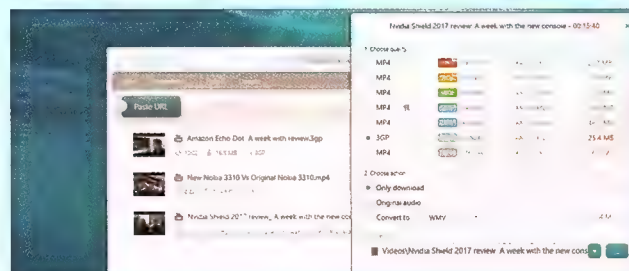
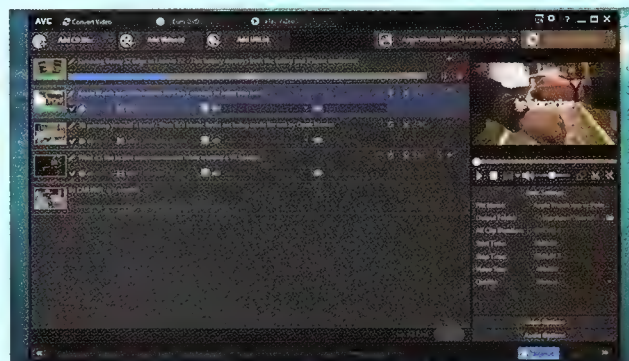
Freemake Video Downloader is much more than a simple YouTube downloader. It supports more than 500 audio and video formats, which helps explain why it's racked up 93 million users. The formats are

organised in profiles for specific devices, so, for example, you can tell the app that you're making a clip for your Xbox 360 or for a PSP and it'll pick the appropriate video and audio formats.

Using it is pretty simple: once the software's running, simply find the video you want in your web browser, copy the address, then press 'Alt-Tab' to Freemake Video Downloader and click the 'Paste URL' button.

The free version of the program is limited to downloading at 4MB/s — that'll be more than fast enough for most people — and it'll add a branded splash to the beginning and end of your video, which you can remove by forking out US\$9 for a one year licence, or US\$19 for a lifetime one.

Freemake Video Downloader burns to DVD and Blu-ray, too, if you've got the appropriate hardware. If you're looking for a do-everything video app, this should definitely be on your shortlist. Cat Ellis & Mark Wilson





OmniOutliner 5

For whether you're writing a novel or a shopping list.

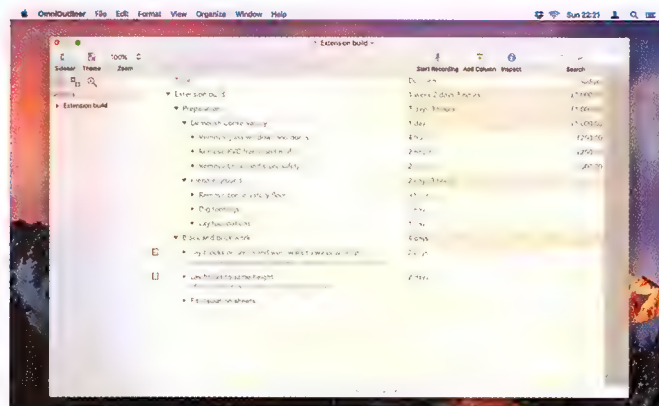
ESSENTIAL, \$14.99; PRO, \$89.99 | OMNIGROUP.COM



OmniOutliner 5 marks the debut of a brand new edition of the Omni Group's venerable outlining tool: Essentials. Priced at only \$15, the simplest way to describe Essentials would be as a cut-down version of its sibling, OmniOutliner Pro. But that would be to do it a disservice, as Essentials is a very capable outlining tool in its own right.

Its developer describes Essentials using words like 'minimal' and 'focused', so you know exactly what to expect — a clean, clutter-free interface and pretty text. There are multiple themes to choose from, each of which specifies things like font and background colour — with a dark mode, too. There are some new features that are common to both Essentials and Pro: live statistics, which tell you how many rows, words and characters you've typed, for example. Support for the new MacBook Pro's Touch Bar is also common to both.

Essentials reads and writes the same file format as Pro, so there's no problem if you want to move to that version later. Speaking of file formats, the iOS version has been upgraded to support this format, too. While Essentials is great for getting started and for most outlining tasks, Pro takes things a step further by allowing you to edit themes and modify the style of individual elements within them. For example, you could change the shading colour on Level 2 rows only, or the text style of Level 1 entries. Pro's real power, though, lies in its ability to manipulate data.



You can add columns and specify that the data is numerical. It can then be formatted as currency — governed by your choice of region in System Preferences.

For indented rows that contain a column full of numbers, their parent row displays a total above that column. This also works for durations, providing you with a simple way of tracking costs or time allocated.

Pro also enables you to save searches as filters so you can easily focus when you need to. The all-important keyboard shortcuts can be customised, and documents can be encrypted, too. Accessing all these tools can be tricky, and when you find them, they don't always work as expected. However, that is our only criticism of an excellent tool that goes beyond traditional outliners.

OmniOutliner 5 is an excellent upgrade to what was already the premier outlining tool on the Mac, and is ideal for making lists, brainstorming, planning a book and so much more. **Kenny Hemphill**

Witch 4

The app switcher goes pro.

\$21.99 | MANYTRICKS.COM



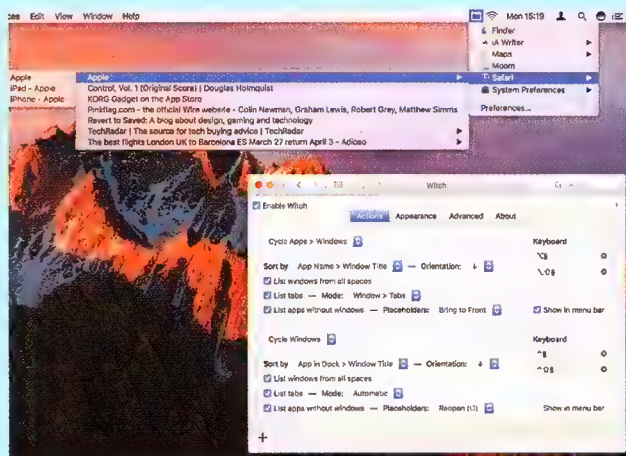
Witch resembles a souped-up version of the macOS app switcher. Along with being able to switch apps, you can delve into windows and tabs, and set up multiple switchers, each with bespoke settings.

This means you can replace the default macOS switcher with Witch's version, while also having Option-Tab trigger a switcher that focuses only on open windows, for example.

Press Down Arrow on a selected icon and Witch lists the app's open windows. Or you can type to start a search — the results list is filtered as you add letters.

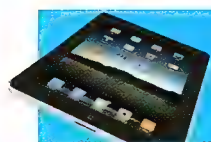
Background apps are included when they have an open window. You can also define an item list's sort order (such as alphabetically). Handily, you can also access switchers from the menu bar to quickly get at your open windows from a small icon.

Witch's preferences enable further tweaking, letting you experiment with fonts and appearance settings, 'spring load' apps to drill down into them after a user-defined delay, and to leave the switcher up when modifier keys are released.

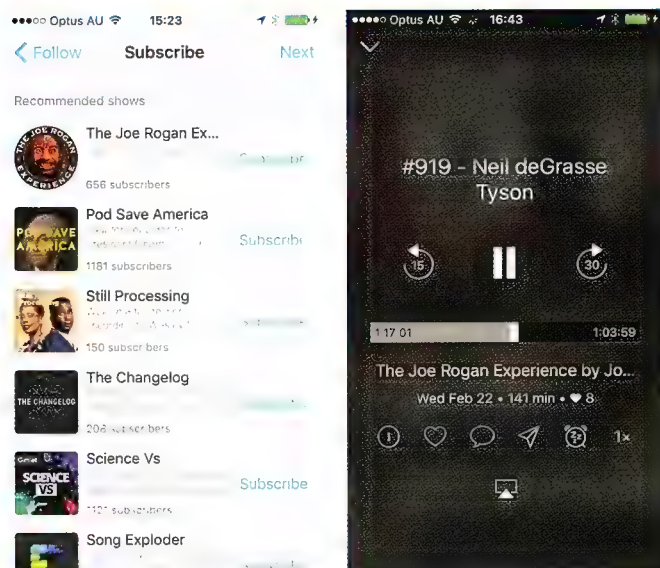


(With that last option, press Esc or click elsewhere on the screen to dismiss the switcher.)

For newcomers, Witch 4 is an excellent and affordable add-on with clear practical benefits. For current Witch users, this is an essential upgrade if you're already a fan. **Craig Grannell**



App Store » iOS APPS



Breaker

Not making very big waves.

FREE | BREAKER.AUDIO



What makes a podcast app 'the best' for a certain platform? Is it more features, less features, usability, the ability to comment and like your favourite episodes, or the price? As Breaker is calling itself "the best", we were interested to see whether we agreed with them.

To start, you can link up Breaker with your other podcast apps so it can transfer your subscriptions – or you can start again from scratch. It recommends productions for you, as well as giving you the option to simply search for them by either typing in the name, or sorting through the most popular from today. A handy touch is showing you how many of its users are subscribed to each podcast, so you can see whether this particular episode is a one-off goodie or if the production as a whole is quite good.

It's super easy to manage your subscriptions after you've added a bunch, too, including the ability to mute – meaning you don't get inundated with new episodes. Another feature you won't find in your stock-standard podcasts app is the ability to follow people, see what they've subscribed to or like, and perve on their activity. The app encourages you to get in on the conversation by commenting on and liking particular episodes and productions, too. As in all online communities, this feature is highly dependent upon its members, so you'll find both useful and pointless comments.

One major flaw we've discovered so far, however, is that there's no apparent way to search a podcast for individual episode names. We listen to select episodes of *The Joe Rogan Experience* (there's over 1,000 episodes so far), so if we want to listen to the Louis Theroux episode... yeah, we're going to be scrolling for a while. The design is quite clean and the UI is otherwise pretty good; however, without that additional search functionality, we can't rightly agree that this is the 'best' podcast app for iOS. **Carmel Sealey**

Truepic

Fighting photo fraud.

FREE | TRUEPIC.COM



Estimates place the number of images being uploaded online every single day at about 1.8 billion, with no guarantees that the photos are genuine or altered. The biggest concern, according to the team at Truepic, is the growing number of fake profile pictures on dating sites like Tinder. In an attempt to ensure photographs online aren't fraudulent, Truepic has launched an app which watermarks images to prove its authenticity. Truepic's SDK is also available for download and can be embedded into other photo apps. All a user needs to do is take a picture either within Truepic or an associated app and the company's patented technology verifies if the image has been edited or not, then watermarks it with a time stamp, geocode and a username. The photograph is also assigned a six-digit code and URL before being stored in the company's 'digital vault'. Users can retrieve the image later via their website. The watermarked image can then be exported for use anywhere online. **Sharmishta Sarkar**

iMotion Pro

Shoot a masterpiece frame by frame.

\$5.99 | FINGERLAB.NET



If you've tried to make stop-motion animation, you may have been daunted by the patience needed to do it justice. Reproducing *Wallace and Gromit* takes lots of time and a steady hand. But with iMotion Pro for iOS, much hassle is removed.

The latest version, 4.0, is highly intuitive. Start a new movie and you're taken to the settings page where you can choose to shoot square or widescreen footage, in 720p or 1080p, by rotating your device. You can select manual control with a single tap (the go-to for stop animation), and alter the threshold of the microphone to capture audio.

There's an option to shoot time-lapse footage and the shutter interval can be set from as short as 0.1 seconds up to an entire day. It's all very slick. Such ease of use extends to the shooting of video. You're given access to a range of tools such as a light, a series of grids for lining up your shots, and both exposure and white balance controls. While you can control focus manually, autofocus works well in adjusting the camera before snapping away.

The accompanying free iMotion Remote app enables you to use another iOS device to control the camera. You can control everything from there, from the focus to the exposure to the grid. The app is strong for editing, too. Aside from speeding up footage and deleting and reordering frames, you can add images and audio. Music from your library must be saved to your device and be unprotected by DRM, though. The app's new ability to duplicate and rename your videos is welcome, and the export facilities remain strong thanks to a wealth of options.

All in all, iMotion Pro is a fun and highly usable creative tool. With simple methods of motion and time-lapse capture, and intuitive frame-by-frame editing, it will have you making stunning animations in no time. **David Crookes**



Google Play » ANDROID



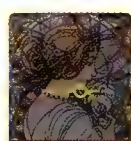
Sketch



Bright



Star



Church



Classic

Philm

Photo filters made for fun.

FREE | PHILM.CC



Between your phone's built-in gallery, the swathes of ever-changing Snapchat filters on offer, and Instagram's editing tools, we still seem to have a remarkable thirst for image-

manipulation apps.

Philm offers dozens upon dozens of filters that you can apply to photos, images in your gallery and also short, 10-second video that you shoot using the app itself. Then there are hundreds of 'stickers' to overlay on your images, ranging from clean and crisp icons, cartoonish emojis to garish figures and characters. There's lots to choose from, and it's simple to use as well.

A slider for each photo filter controls how intense the effect is, though the difference between some of the effects is insignificant the more you swipe left through the menu. You probably wouldn't use this app on its own, as there are no editing functions, so you'll have to find another way to crop your photo or adjust the rotation in case it's a bit wobbly. For the price, it's a bargain, and there are no ads. **Paul Taylor**

Can I Fly There?

Probably not!

FREE | WWW.CASA.GOV.AU/DRONEAPP



With the proliferation of more affordable consumer drones, it's not surprising that there are ever-increasing regulations being put in place to temper their usage. This app asks the simple question 'Can I fly there?' and is made by the Australian Government in partnership with Drone Complier, relying on information sourced from Airservices Australia.

The essence of the app is a map showing your local area (you can drop a pin wherever you want information, or use your GPS location) with a visual representation of any restrictions and the radius that they affect. This entails an overwhelming variety of conditions and restrictions, a lot of which would be difficult to keep tabs on if it weren't for a comprehensive app — an example being to only fly at an altitude below 45m when within a certain radius of a hospital (due to its helipads).

Some extra useful information is provided as well, such as the local weather conditions, seven-day forecast, and a host of links to further regulations. **Harry Domanski**

DirectChat

Making chat easy.

FREE | TINYURL.COM/APC444-DCHAT

This messaging app bears a striking resemblance to Facebook Messenger, as it uses floating bubbles on the side of your screen. Once you've given it permission, DirectChat reads all incoming messages from your SMSes, Facebook, Whatsapp, work chat clients and so on, and puts a bubble on the side of your screen. Simply tap it to open the message and reply from there.

There are limitations, as it only displays new messages, not the conversation so far (you'll have to go to the app for that) and any app system functions such as GIFs or special commands won't work here.

However, it's very clean and useful, unifying everything into the one place, and floats on top of other apps, making it very quick. The free version is ad-supported and gives access for up to 12 different apps, while the paid version for \$2.59 offers customisation, and unlimited access. Considering how unobtrusive the ads are (you only see them when you're fiddling with the settings), you could feasibly use the free version forever. **Paul Taylor**





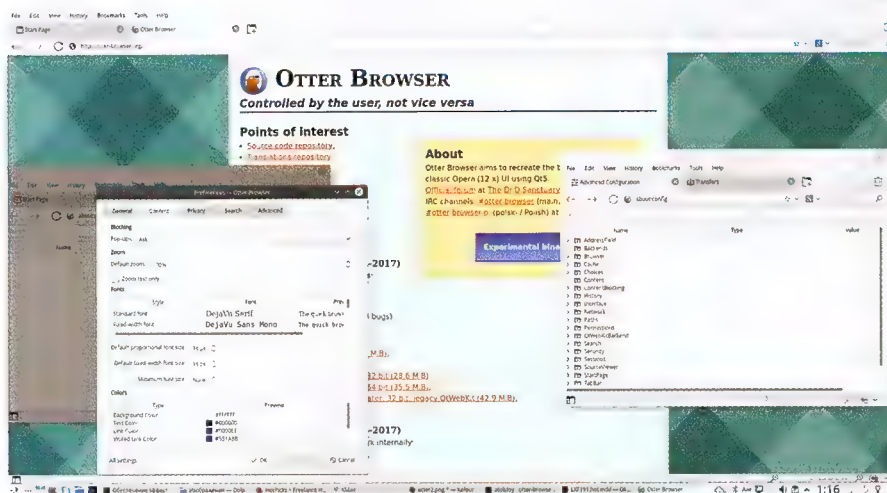
Otter Browser

A web browser
for browsing better.

FREE | OTTER-BROWSER.ORG

Although new Firefox and Chromium releases have arrived relatively recently, we decided to skip those already widely known and threadbare browsers in favour of a fresh alternative. The historic roots of the Otter Browser were of utmost importance back in 2012 and related to the decision of Opera Software to give up on its Presto rendering engine. Otter Browser emerged to recreate the 'feel' of the original Opera 12.x browser on the basis of WebKit and Qt5.

We've investigated earlier versions of Otter Browser, but it was honestly not ready for daily use at that point in time. Revisiting the project after two and a half years revealed the titanic progress that Otter's developer has achieved. It's worth visiting the project's website on Tuesdays to read the updated weekly report, with the number of commits, fixed and remaining issues, and get binary versions of Otter Browser for any major OS. Each week through the years, the diligently maintained blog delivered the up-to-date progress.



"O snail, climb Mount Fuji, but slowly, slowly!"

You got it right: Otter Browser is now much better than it used to be, so we gave it a test drive for a couple of days and didn't encounter too many errors. The browser experience is not ideal with the default QtWebKit back-end, but you can switch it to the newer QtWebengine (which is technically a stripped-down Chromium engine) and make things even better on many modern and heavy websites.

Otter also sports many usability power-ups that used to be present in the now-abandoned Opera 12.

Downloads, notes, cookies, password, ad-blocking lists as well as history and bookmarks all have great handy management sections that are easy to use. The browser has traditional tree-style web-related settings at About:config and the separate 'Tools > General Settings' interface for fine-tuning the browser itself.

The light, productive and feature-rich Otter Browser looks very promising and will obviously fit anyone's desktop. The server-side sync feature is designedly absent, because it's you who should control the browser, not vice versa. **Alexander Tolstoy**

Simon

Simon says... control your PC with your voice.

FREE | SIMON.KDE.ORG

First attempts to vocalise text into speech and, reversed, transcribe human speech as text date back to the mid-'90s, when PCs became capable of multimedia features. But even nowadays, the ability to control your system with your voice still sounds futuristic, or at least it's rarely used. We don't know whether this is due to complexity, but with Simon, things turned out to be quite affordable for an average user.

Simon is an open-source speech recognition system that can be useful for fun projects, but also in cases when, for some reason, you can't use a mouse and keyboard for input. Simon uses the KDE libraries, CMU SPHINX and/or Julius, coupled with the HTK, and runs on Windows and Linux. The application offers an appealing Qt4-based GUI and sports many means to bring the complex task of speech recognition closer to a newbie.

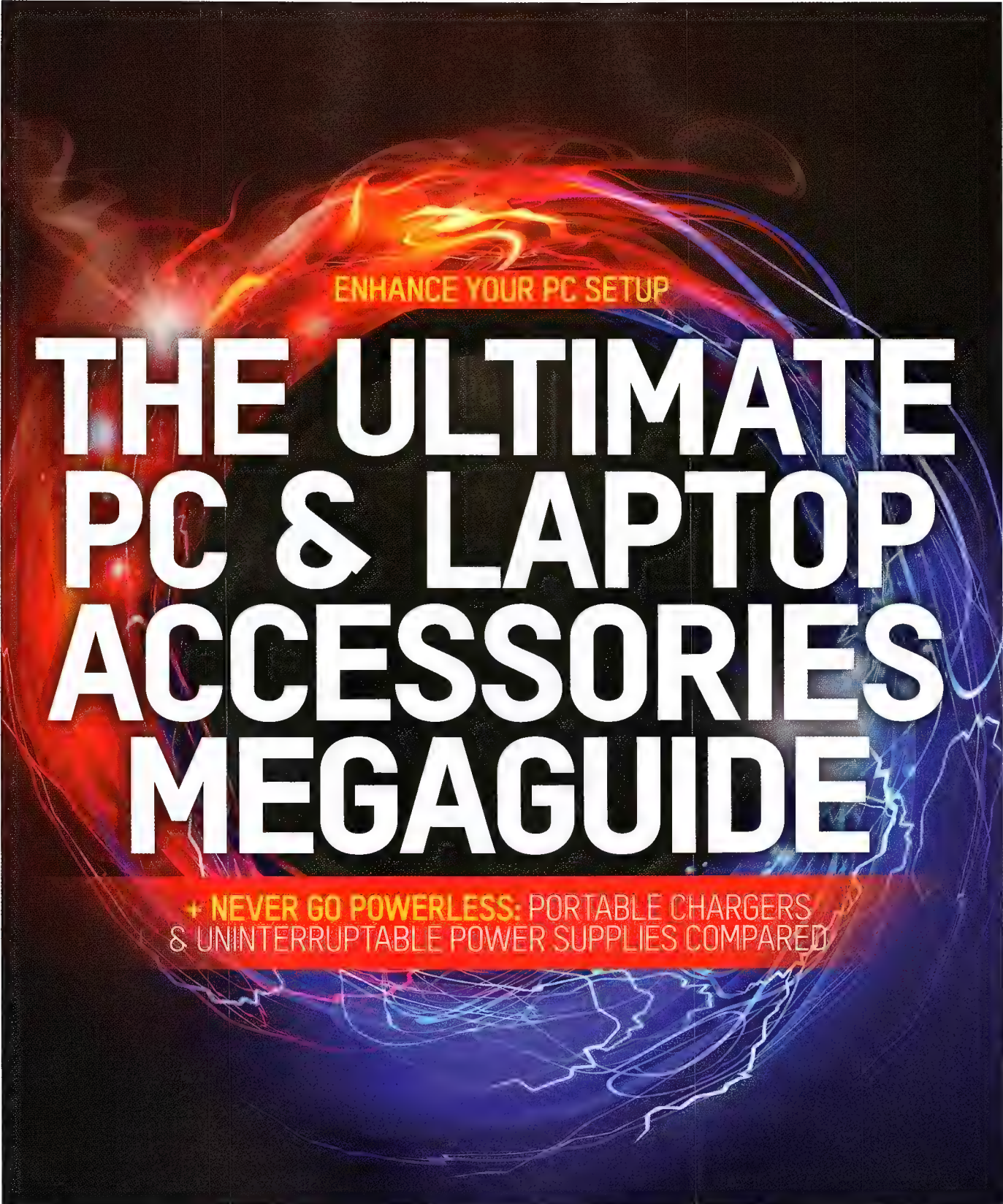
We deliberately used the term "affordable" instead of "easy", because you still need to do some preliminary work before Simon can do anything in return. The two main things Simon wants you to do are speech (or acoustic) model and scenario.

Simon can use two different speech recognisers: Julius and PocketSphinx, both being available in most Linux distros.

Having set up the recogniser, you only get a static speech model, which is unlikely to be optimal, so you might want to adapt the model to your voice. Simon lets you train your model once you have the SphinxTrain package installed and provide the language rules set known as Hidden Markov Model Toolkit (HTK) to generate the speech model. Then you need to couple the model with a scenario to let Simon actually control something on your desktop. Both models and scenarios can be retrieved using the Get New Stuff feature that links Simon to store.kde.org, or you can browse available models manually at www.voxforge.org.

It takes some time and effort to get stuff to work, enrich the model with real samples of your voice and finally use a scenario to control your mouse, web browser and so on, but the results are usually breathtaking!

Alexander Tolstoy



ENHANCE YOUR PC SETUP

THE ULTIMATE PC & LAPTOP ACCESSORIES MEGAGUIDE

**+ NEVER GO POWERLESS: PORTABLE CHARGERS
& UNINTERRUPTIBLE POWER SUPPLIES COMPARED**

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BOOST YOUR LAPTOP OR PC'S CAPABILITIES

Get better productivity, ergonomics and maybe even performance with a laptop dock, cooler, stand or riser.

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C-ING THE FUTURE

The newest USB plug standard promises a lot, but it's up to the peripherals to actually deliver. We test 11 accessories that use USB-C.

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STAYING POWER

Running a home server, NAS box or always-on PC? A low-cost uninterruptible power supply can save you from disastrous data loss and protect against power surges. We compare nine.

68

RECHARGE ON THE RUN!

Always running out of battery? We test 10 portable power banks that'll let you recharge your gadgets — and even laptops — while you're on the move.

Boost your laptop (or PC's) capabilities

Get better productivity, ergonomics and maybe even performance with these docks, coolers, stands and risers.

Ultrabooks have become so thin over the past couple of years that the connection interfaces we regularly use have become the bottleneck in making these devices even thinner. Many flagship ultrabooks have ditched these superfluous connections in lieu of the USB Type-C one-interface-fits-all solution and yet the need for Ethernet, display connections and additional USB sockets is as necessary as ever.

Laptop docks can add the option for an efficiency-boosting second screen, the stability of a direct Ethernet connection and then throw in a few extra USB ports and conveniently-located audio and microphone jacks.

The other major limitation of ultra-thin laptops is thermal management and, for this, there are plenty of laptop cooling risers available that'll keep a computer's internals up to about 2°C cooler. If you happen to have an ultrabook or tablet that suffers from thermal throttling, then a cooler will be a welcome addition, but cooling laptop risers also position the unit better for viewing, promote longevity by keeping components cool and even sometimes add USB ports to your device.

HOW WE TESTED

Laptop docks were tested on various PCs running Windows 10 and Macs running OS X 10.9.5 for both display and port compatibility. USB 3.0 outputs were tested for speed using CrystalDiskMark 5 and an external SSD. Ethernet ports were tested using Ookla speed test.

LAPTOP & PC DOCKS



\$160 | WWW.J5CREATE.COM

J5create mini ultra station (JUD530SE)

Rather ugly and rather useful.

The J5create mini ultra station is small and light, at 106.5g. The slim cylinder-esque design and aluminium finish would pair well with most laptops, although the rubber bands that help hold it in place really spoil this image.

Even with this extra grip, the addition of a few cables quickly outweighs the dock itself, particularly if you use anything bulky like a VGA cable. One product image shows the laptop actually resting on the dock and using the rubber bands as grip, thus alleviating the aforementioned problems – although when trying this, we did find our laptop moved more than we would like.

As for connections, it's a pretty standard affair, with HDMI and VGA for display, three USB 3.0 ports (two of which offer 2A fast-charge), a Gigabit Ethernet port, and audio and mic jacks. This is a fair unit if you want something portable, but just remember you'll have to lug around the bulky power adapter and all those cables as well.

Verdict

A versatile and compact connectivity pipe that'll add another screen, Ethernet and a heap of USB ports for very little outlay.



\$349.95 | WWW.KENSINGTON.COM/AU

Kensington SD4600P USB-C Dock

Excellent for adding Type-A 3.1 ports.

USB Type-C, whether it uses 10Gbps USB 3.1 or the 40Gbps Thunderbolt 3 technology, is so fast that you can add just about every other interface you want to it and not have to worry about clogging the bandwidth. On top of this, it adds the capacity for up to 100W of power delivery, which is going to be more than adequate for any modern laptop without a dedicated GPU.

As one of the only docks in the roundup to utilise Type-C, it's surprising that the SD4600P gets 60W of charging power (the Surface Pro 4 draws less than 40W), three USB 3.0 sockets, a Gigabit Ethernet port, an HDMI connector, a DisplayPort, two USB Type-C sockets and the usual 3.5mm audio and microphone jacks all out of one PC connection.

What's perhaps even more impressive is that it can carry a 60Hz 4K screen signal as well. Although on the pricier side, when you consider what you get, it's hands down one of the better value offerings.

Verdict

This dock adds a premium suite of interface options, charging and some impressive additional screen expansion bandwidth.





\$99.95 | WWW.MBEAT.COM.AU

Mbeat M-Sleek Universal Docking Station

An ultraportable docking wand.

The Mbeat M-Sleek UDS makes the case that useful docks don't actually have to be any bigger than a perfectly transportable laptop-width wand. Despite this black cylinder's rather miniscule profile, it's not at all short of connectivity. Starting it off is four USB 3.0 outputs that we could only get to transfer at 37MB/s and 38MB/s sequential read and write speeds rather than the usual 310MB/s and 215MB/s rates due to some driver issues (there are no drivers for Windows 10 yet).

Anyone using a laptop that lacks an SD card reader will be pleased to note that the M-Sleek UDS not only has a regular SD card reader, but also includes a dedicated microSD card slot. The feature sitting on top of the pole is a 100Mbps Ethernet port that happens to be useful enough to almost warrant the cost of the dock on its own, if your laptop is missing this crucial hardwired connection.

Verdict

A good budget-conscious choice for anyone looking to expand their ports and connections, when they work...



\$139 | WWW.SHINTARO.COM.AU

Shintaro Blazer Docking Station

Bang-for-buck solution for Windows users.

The Blazer Docking Station from Shintaro is an upstanding contender for value, with a low price-point and plenty of connectivity on offer. It feels more like a modem or router, with a tower design and indicator lights for power and connections, but this works quite well sitting next to your monitor as it has a small footprint.

On the front of the unit, you have audio and mic jacks, as well as two USB 3.0 ports. The rear features connections that would typically stay connected, with four USB 2.0 ports, Ethernet, HDMI and DVI (both supporting HD output), with the device's stand compensating well for the extra weight and pull this cabling brings.

This dock is intended to be left with your monitor and other peripherals, and suits this task well. For the price, there isn't much contest for a simple and capable dock; however, the exclusion of a fast-charge port and its incompatibility with Mac will give it a disadvantage in the current climate.

Verdict

This PC exclusive offers a wide range of connectivity options and bundles in Ethernet and six USB sockets for a good price.



Laptop docks buyer's guide

What you need to consider when considering a laptop dock...

Video card

Work out the exact monitor setup you would like to use or what you would like to grow into before you start looking, as this will be the primary expense in whichever dock you choose.

Primary interface

Most of the units we tested use the USB 3.0 interface as the 5Gbit/s theoretical transfer speed is more than enough to run all ports at full speed, though the more advanced dual 4K display capable docks will require USB 3.1 Type-C connections.

Headphone/mic jacks

Some of the units add headphone and microphone outputs to the front of the dock for easy access.

Front USB ports

Easy-access front-facing USB ports are never a bad thing... if you can live with the few models that support them.

Portability

Although docks will generally be used to make it easier to move your laptop rather than the dock itself, sometimes you'll want to actually take your additional connectivity with you.



\$430 | WWW.STARTECH.COM.AU

StarTech Triple Monitor Docking Station (USB3DOCKH2DP) A mammoth all round.

The StarTech isn't much to look at, but it's bristling with connectivity. All but two of its ports run along the same face of the long, squat brick, but this actually makes a heap of sense. The accessible side-panel sports a USB fast-charge port, and a dual-audio headset jack, meaning that the cables that run out and in front of your laptop won't be entwined with the rest of them at the back.

The meat of this unit is its ability to connect up to three monitors at once – with an HDMI and two DisplayPorts (one of which can operate at 4K), you can run quite a luxurious desktop setup from your laptop. The ensemble is rounded out with five USB 3.0 outputs, an Ethernet port and another pair of audio and microphone jacks for your speakers and external mic.

Overall, it's a sturdy and pricey unit with abundant connectivity, and although focusing on utility rather than aesthetics, the design lends itself to be hidden behind the laptop anyway.

Verdict

If you want the multi-monitor hacker setup from Swordfish, then you'll need this 4K and dual QuadHD tripple display from StarTech.



\$345 | WWW.STARTECH.COM.AU

StarTech USB 3.0 Laptop Dock 4K An elegant beast in an elegant box.

Don't underestimate this cute little box. The form factor is perfect, with a size and weight that is solid enough for a desktop unit and compact enough for a portable solution – not to mention the sexy simplicity of the design.

The HDMI offers 4K resolution if used alone, but with a dual monitor setup, both the HDMI and DVI connections run at Full HD instead. The two display ports are found with the majority of the connections on the rear of the device, while the rather tidy and convenient front just has two USB 3.0 ports with fast-charge, and a headset jack.

It feels like a more viable portable alternative than the 'wand' style docks as it has a sturdy construction while remaining compact, and it also feels like a much neater desktop docking solution given its tiny footprint and clever placement of ports. The unit would receive a perfect score if it weren't for its cost, as you can find considerably cheaper (and uglier) devices that have similar features.

Verdict

A compact, but full featured 4K-capable dock that looks nice and works with almost any laptop through a USB Type-A connection.



\$299 | WWW.MYTOSHIBA.COM.AU

Toshiba Dynadock 4K A dynamite 4K docking station.

This vertical slab spruiks itself as having the ability to output at 4K via HDMI, a handy feature of the HDMI 2.0 connection. Despite the fact that many of the higher-end docks we tested have HDMI 2.0 and some even allow 4K at 60Hz and dual 4K at 30Hz (rather than the Dynadock's 4K 30Hz max output), this unit is still above average when it comes to the videocard's single 4K output. An additional DVI-I monitor output will let you use dual monitors in full HD at 60p and there's even an additional DisplayPort, though it's a mutually exclusive choice between this and the HDMI port. Six USB 3.0 ports come bundled, four sit at the rear and two are conveniently positioned at the front of the unit alongside the headphone and microphone 3.5mm jacks. To round it out, the dock's final feature is a Gigabit Ethernet connection that ups the ante from the expected 100Mbit/s sockets, to give you ample speed on your local and internet networks.

Verdict

A flexible unit that can display across two monitors or at resolutions up to 4K via DVI-I, DisplayPort or HDMI for a reasonable price.



LAPTOP COOLERS, STANDS AND RISERS



\$65 | BELKIN.COM/AU

Belkin CoolSpot Laptop Lounge

One for those who
can't stand the heat...
on their laps.

This fairly minimalist laptop stand is flexible enough to sit on either a desk or your lap – and it's quite lightweight. Its construction combines a hard-plastic top with a fabric-covered foam underside, with the latter being quite firm but still comfy when sitting on your lap. A rubber strip across the front helps keep laptops from sliding off, too.

Cooling comes via a hole straight through the centre of the pad, which houses a single 75mm fan. That draws air in through the back of the pad (via a large open-grilled vents) and also from directly underneath, with this cooler air then blown directly up onto your laptop's underside. While it's not overly loud, if you're sitting in front of it, you will hear that fan when it's switched on – and it spins up immediately on being plugged in, with no actual on/off button.

Its cooling abilities were a bit mixed, knocking 1–2°C off our gaming laptop while idling, but doing basically nothing (or heating up by a degree) under load. Passable, if not great.

Verdict

Not the best tabletop cooler, but if you want to keep your legs (rather than your laptop) cool, then it's a worthy candidate.



\$79 | WWW.COOLERMASTER.COM

CoolerMaster MasterNotepal Maker

A well-balanced option
with some perks.

The Maker SKU comes with a modular fan structure to allow you to tailor the airflow for your particular laptop. Conceptually, being able to position your fans is a fantastic idea, but much like building a PC, it wasn't long before the limitations of the fans flexible positioning started to appear. The casing inhibits the individual fan's movement to around 2cm in any direction.

Fortunately, the customisability wasn't the only thing going for the Masternote Pal series which features a perforated metal facade that feels cool to the touch and affords ample airflow that keeps the laptop between 2°C and 4°C cooler when resting and up to 2°C cooler under load.

There's also three USB 2.0 outlets, one USB 3.0 socket, an excellent cable management system and movable rubber stoppers that do a good job of allowing you to utilise the riser's most extremely angled positions.

Verdict

Moveable fans, a clever cable management system, USB hub and six display angles make this modular cooler an appealing offering.



Laptop stands buyer's guide

What you need to be aware of when shopping for a laptop stand, riser or cooler.

Riser angle

The first thing you are going to want to consider when it comes to laptop coolers is whether or not it has a riser, and if so, whether the angle/angles it sits at will be convenient for your usage purposes.

Size

Depending on the size of the laptop (or laptops) you wish to use the cooler with, it's worth noting the maximum size each will take. CoolerMaster's SF-19V2 will accommodate a 19-inch laptop, but many max-out at 15-inches.

USB hub

Some of the coolers will come with multiple USB outputs to double as a USB hub. Depending on the model, there will be variations on the number of USB 2.0 and USB 3.0 outputs.

DC or USB power

Dual fan risers require a little more grunt and manufacturers generally deal with this by having either multiple USB inputs, a USB 3.0 input or a supplementary wall plug.

Number of fans

There are a few things to consider when getting a laptop cooler, but we've found that more fans generally equals a greater capacity to move air and, therefore, a greater cooling effect.



\$200 | WWW.COOLERMASTER.COM

Cooler Master SF-19 V2

This 'yuge' cooler is the best cooler — trust us.

This unwieldy looking beast is designed for gaming laptops, so if you want something to put your dainty little MacBook Pro on, go look somewhere else. If you happen to own one of the premium high-end devices the SF-19 V2 is designed for, then you'll likely be impressed: it functions more as a cooler than a laptop stand, though it's definitely the latter, too. It's quite niche, though, as it supports 19-inch laptops and they are, understandable enough, quite rare.

Still, this is capable of keeping your device cool (thus mitigating any performance issues — no doubt attractive for competitive gamers), and it's even got a bunch of RGB lights in it with seven changeable colours. The pair of turbine fans can be shifted around if you like, and the modular design is very easy to use and not at all fiddly. Indeed, the unit requires basically no set up, and it boasts four USB 3.0 ports.

Verdict

It's expensive, but if you have a big laptop and you're focused on high-end gaming, then this is probably your best option.



\$24 | WWW.DEEPCOOL.COM

DeepCool Wind Pal Mini

The perfect first step in laptop cooling.

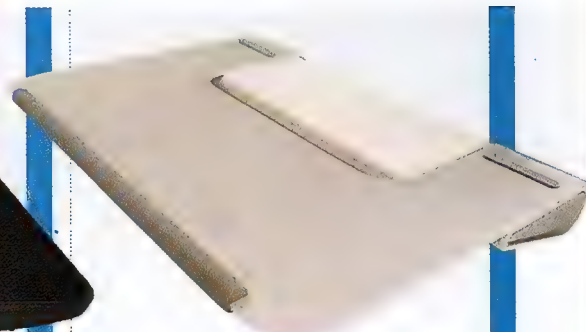
If your purpose is simply to cool your laptop and a gentle incline is all you're after from a stand, then it's hard to go past DeepCool's well-priced Wind Pal Mini. The unit's been fitted out with a subdued black metal mesh facade that looks stylish and transfers heat well, and the USB-powered 14cm fan is generous enough to keep the unit a couple of degrees cooler when resting.

Unfortunately, the unit doesn't do as well under load, only managing to make the laptop about 1°C cooler than it would normally be across the CPU and GPU. The 7° angle incline is particularly comfortable and though it only comes in one colour, we're actually rather fond of the unit's blue LED backlight. The 1,000rpm fan is suitably quiet and you will barely notice the 22dB fan noise.

Despite not getting the highest scores on cooling under load tests, it still makes a difference to overall laptop temperature and costs next to nothing.

Verdict

This single-position laptop cooler is rudimentary but does everything you want it to and costs next to nothing.



\$88 | WWW.DEEPCOOL.COM

DeepCool U HUB Notebook Cooler

Why would anyone go for this combo...?

Although the U HUB Notebook Cooler has 'cooler' in its name, the unit hasn't actually been endowed with any fans and, as such, really doesn't have any impact on the temperature of a laptop in any discernable way. For consistency, we recorded the resting and load temperatures of the test laptop while on this riser and found that it was up to 2°C hotter in both conditions than what was recorded on the testing table. The company suggests wedging it between your legs and laptop in order to stop your legs getting hot, but we really struggle to see this as a redeeming use for the riser. Fortunately, the unit has four USB 3.0 ports and a fifth microUSB-B connector to the PC that will allow you to utilise full USB 3.0 transfer speeds (at least when only using one at a time).

The DeepCool U HUB Notebook Cooler is available at Officeworks for laptops up to 15.6 inches, but we really wonder why you would when it comes in at a surprisingly high \$88.

Verdict

A bit pricey for a single-display-angle laptop stand and a few USB ports.





\$287 | WWW.OFFICEWORKS.COM.AU

Kensington SmartFit Dual Monitor Arm Mount

Arm your PC.

The Mount uses a table clamp to create the 'floating monitor' setups you see in movies. The system comes with an arm to mount a monitor and another to hold a laptop at eye level – though that plate can be detached and a second monitor attached. While you won't need to get out your toolkit to put it together, there's about an hour of DIY assembly required – if you're not an 'IKEA person', we'd recommend steering clear of this logical jigsaw puzzle. Once up, the system works well, and as long as you have the required space. Unfortunately, you only get horizontal and tilt movement by hand (vertical positioning requires the less-immediate adjustment of levers on the supporting base).

You should definitely check you have the space to support this setup and, moreover, whether or not the monitors you plan on using have the necessary square four screw support mechanism, as not all monitors are compatible with the brace.

Verdict

A decent solution for professional-level monitor support without having to get the tools out.



\$140 | WWW.KENSINGTON.COM

Kensington SmartFit Laptop Riser (Qi)

Elevate your laptop, charge your phone.

Out of the box, you'll need to bolt the base to the stand, and there are four colour-coded height options (which you can select based on how large your hand is. On these terms, the SmartFit does its job, though the stand does wobble a bit if you touch it with your laptop applied.

The real novelty here is the wireless phone charger installed discreetly in the base: once you've hooked it up to power, you'll be able to place your phone on this surface and have it charge without cords. This package also has Zero Footprint mounting, which means that, if you have a Kensington universal dock, you can place it underneath the laptop stand.

Where cables are needed, you'll be able to run them in grooves beneath the stand – so if you're looking for a way to keep your laptop setup a bit tidier, this one can certainly help. Just make sure you have a screwdriver at hand if you purchase the SmartFit, though putting it together is very simple.

Verdict

A simple non-cooling laptop riser that adds some Qi wireless charging smarts to the equation.



\$69.95 | WWW.TARGUS.COM/AU

Targus Chill Mat Plus+

A bit of a minus in our opinion.

This isn't the cheapest laptop cooler on the market, and despite having a subtle grey and black profile, Targus has chosen to make the angle clasp yellow. The oddities don't end there. Even though the riser comes with a 5V DC power port, the package doesn't actually include a DC wall plug, instead deferring to a standard USB power cable. If you have a USB 3.0 output, it'll be sufficient to power the fans and even leaves some spare power for the four USB 2.0 ports, but this will reduce the speed of files transferred on an external SSD from 250MB/s+ to less than 40MB/s. If you have a slightly older computer with no USB 3.0 ports, then you will not be able to power any more than the fans without the optional extra DC power. To cap it off, we noticed only 1°C of difference in both resting and under load temperature tests, so it isn't exactly a high achiever. The Chill Mat Plus does what it sets out to, but seems to come with a hefty premium.

Verdict

The Targus Chill Mat Plus does the basics, but is a little too expensive to miss out on mains power and a subtle design.



C-ing the future

The newest USB plug standard promises a lot, but it's up to the peripherals to actually deliver. Jenneth Orantia tests 11 accessories that use USB-C.

You know a technology is headed for the scrap heap when Apple gives it the boot. We saw this happen with optical drives, and with hard drives to a lesser extent, but the newest MacBook takes this phenomenon to new heights by doing away with USB, HDMI, SD and even the charging port, in favour of a single USB-C connector.

USB-C is the latest flavour of USB, and it's a massive upgrade on what's come before it. This port can provide up to 100W of power (which is more than enough to power a full-sized laptop), supports video output up to 4K video resolution, and can transfer data at up to 10Gbps. It also uses a completely reversible design, so that plugging it in the wrong way is impossible.

USB-C brings us closer to the geek's Holy Grail of using a single cable for everything, but it isn't without teething problems. The main issue is that any peripherals, devices and cables using the older USB plug can't be plugged into a USB-C port, which, at the very least, means you'll need a USB-A to USB-C adapter to connect legacy equipment.

But what about those devices that are USB-C compatible? Here are a few examples of what's out there.

USB-C STORAGE DEVICES



\$160 | WWW.G-TECHNOLOGY.COM

G-Technology 1TB G Drive mobile USB-C

Nuthin' but a G thang.

Portable, 1TB hard drives are practically a commodity, so an asking price of more than \$100 means there's something that sets it apart from the norm. The G-Technology 1TB G Drive, which boasts a faster-than-average spindle speed of 7,200rpm, a USB-C connector, and colour options to match the new MacBooks.

The former means it's theoretically able to deliver data about 33% faster than a 5,400rpm drive, while the USB-C connector promises transfer rates of up to 136MB/s. It benchmarked slightly better than the promised 136Mbps, reporting sequential read and write speeds of 141MB/s and 135MB/s, but these speeds were only slightly higher than the LaCie rugged (right), which uses a slower 5,400rpm drive.

For day-to-day use, the G Drive can transfer 10 movies – or 17.65GB worth of files – from a laptop in 2 minutes and 18 seconds, and vice versa in 2 minutes and 7 seconds.

Verdict

While boasting a faster-than-average rpm, real-world testing didn't deliver as speedy results as the price may suggest.



\$260 | WWW.LACIE.COM/AS/EN

LaCie 2TB Rugged USB-C Evolution Orange.

LaCie's unique range of rugged hard drives has been a mainstay of the peripherals market for several years now, and for those who've experienced hard drive failures in the past, the durable, drop- and crush-resistant enclosure – which claims to survive drops of up to 1.2 metres and being driven over by a 1-tonne vehicle – may be worth the added expenditure.

As rugged as it promises to be, it still has a 5,400rpm spinning hard drive inside, which means it isn't as durable as an SSD. It's really a trade off between cost and performance: the equivalent-sized SSD from the likes of Samsung offers up to four times the speed but costs nearly 1,000 bucks more.

Nevertheless, the newest USB-C version of LaCie's rugged range acquits itself reasonably well in the benchmark tests, achieving 136MB/s read speeds and 134MB/s write speeds in Crystal Disk Mark. Transferring 17.65GB from the laptop to the drive over USB-C took 2 minutes and 16 seconds.

Verdict

Featuring a heavy-duty enclosure, this hard drive may only spin at 5,400rpm but still manages speedy reads and writes.





\$58 (128GB) | WWW.SANDISK.COM.AU

SanDisk Ultra USB Type-C Flash Drive

Made for mobiles.

If you're rocking both a laptop and smartphone with USB-C connectivity, SanDisk's newest flash drive can make file transfer between the two easier. It's available in capacities of up to 128GB, and while it has decent read speeds of up to 150MB/s, write speeds are a much slower 48MB/s.

The latest Android phones already do a good job of automatically saving your photos and videos to the cloud, but the SanDisk drive offers a way to save a local, tangible backup of all of the photos, videos, music and files stored on your phone – either manually or automatically – via the free SanDisk Memory Zone app.

There's also an option to back up the photos and videos on your Facebook, Instagram and Picasa accounts; however, we kept on getting error messages whenever we tried this. Windows and Mac users aren't as well-catered for, but more features are available in the paid version for \$17.

Verdict

While the SanDisk offers manual and automatic file backup, it performs some functions rather slowly.



\$569 | WWW.SEAGATE.COM/AU/EN

Seagate INNOV8

More beauty than
brains.

Forget everything you ever knew about the boxy, plastic hard drives of yore. The Seagate INNOV8's dark metallic finish and layered grill design brings to mind a luxuriously appointed Bentley.

The INNOV8 houses a whopping 8TB of storage on a single 3.5-inch hard drive, but even more remarkable is the fact that it doesn't require an AC power supply – it's powered off USB-C using the wonders of USB-C Power Delivery.

Weighing in at a considerable 1.5kg, it's more transportable than mobile. But given the single hard drive also means a single point of failure (in other words, no redundancy), you wouldn't want to be carting this around too much anyway.

Performance is a mixed bag. Using the Crystal Disk Mark benchmarking tool, it reported an impressive 203MB/s read speed, but only 65MB/s write. This means it takes longer to transfer files to the drive, with a 17.65GB collection of 10 movie files taking 10 minutes and 10 seconds (or nearly five times longer than the other drives on test).

Verdict

It may look like a Bentley, but it drives like a Barina, with stylish looks but sluggish performance.



What's new with USB-C?

It's the future of USB, but how bright is it?

While the presence of USB-C promises a multitude of next-gen functionality, it isn't a new version of USB per se. USB-C is simply a different type of connector, but the actual USB standard that it uses can vary from the ageing USB 2.0 (which is capped to transfer speeds of 480Mbps and power output of 2.5 watts) through to USB 3.1 Gen 2 (which offers up to 10Gbps data transfer and up to 100 watts of power).

To muddy things even further, the Thunderbolt 3 standard (found on the latest Mac and Windows laptops) also uses a USB-C connector, and is capable of 40Gbps per second data transfer and both HDMI and DisplayPort 1.2. But it also uses USB 3.1 Gen 2, so non-Thunderbolt devices can be plugged in with no issue.

The other factor at play that can affect the data throughput achieved is the device that you're transferring data from. No matter how fast the USB-C device is, it will revert to the speed of the slowest device connected. If you're copying files over from a laptop hard drive, for instance, the bottleneck will be the drive interface, which can't get anywhere near USB-C's maximum speed.



CABLES, ADAPTERS
AND HUBS



\$35 | WWW.APPLE.COM/AU

Apple USB-C to Lightning Cable

Thunderbolt and Lightning, very very frightening.

While we can admire Apple's bold vision of replacing every connector with USB-C on its latest MacBooks, it does put out iPhone and iPad users, who have no way to physically connect their mobile devices without plumping for a new USB-C to Lightning Cable.

Despite the newer connector at one end, however, don't expect USB-C speeds when transferring data. The bottleneck is the iPhone or iPad, which — save for the latest generation of iPad Pros — are limited to USB 2.0 speeds of up to 480Mbps.

Perhaps the greatest indignity of having to purchase an extra cable as a reward for slavish Apple devotion is the fact that the Cupertino company's cables are pretty poor quality to begin with. We've gone through multiple Apple cables where the head has frayed or the connector has stopped registering, and this one is bound to follow suit.

Verdict

It won't upgrade your iOS devices to USB-C speeds — bottlenecks will occur on the phone or tablet — but it otherwise works fine.



\$40 | WWW.BELKIN.COM/AU

Belkin Mixit DuraTek USB-C Cable Built with DuPont Kevlar

Almost indestructible.

One of the annoying realities of computer cables is that they'll inevitably fail. Usually, it's because the wiring inside has frayed due to all of the twisting, yanking and tangling it gets subject to on a regular basis. Belkin offers a solution in the form of its Mixit DuraTek line, which has been updated for USB-C. Kevlar reinforces the internal wiring, and combined with the double-braided nylon on the outside and a connector head made of thermoplastic elastomer, the Mixit is said to be durable enough to withstand more than 5,000 bends.

Not convinced? Belkin backs it up with a five-year limited warranty against breakage. Besides which, the Mixit just plain looks nice, with colour options that closely match the new MacBook range, and the 1.2m length is longer than average.

But note: this cable doesn't support the newest USB 3.1 speeds; data transfer is capped to 480Mbps.

Verdict

Very durable and with a generous length, this cable is almost indestructible; however, don't expect more than USB 2.0 speeds.



\$530 | WWW.BELKIN.COM/AU

Belkin Thunderbolt 3 Express Dock HD

Room for improvement.

Sure, you could purchase a second laptop for the same asking price as Belkin's newest Thunderbolt dock, but its primary target is those who've already paid thousands of dollars for one of the top-end Windows or Mac machines. In this case, shelling out another \$500 or so to maximise its functionality isn't unrealistic.

Connecting via USB-C, the Express Dock HD adds three USB 3.0 ports, two USB-C Thunderbolt 3 ports (one of which is used to connect to the host computer), DisplayPort, Gigabit Ethernet and audio out.

Our main gripe isn't so much the price, but the missing slots that you'd rightfully expect to be included at this price level, such as an SD card slot — a curious omission given the dock's appeal for creative professionals. While DisplayPort 1.2 is undoubtedly the superior video standard, the fact is that most external displays use HDMI, which means you're likely to need yet another adapter.

Verdict

Expensive and lacking some fairly vital addages, this dock just simply doesn't quite functionality worthy of its asking price.





\$70 | WWW.LASERCO.COM.AU

Laser USB-C 5-in-1 Multiport Adapter

A smart buy for the laser-eyed.

If you own one of the new MacBooks, do yourself a favour and pick up the Laser Multiport Adapter. This relatively inexpensive, pocket-sized dock turns the one measly USB-C port into the assortment of ports and slots that it should have had in the first place — two USB 3.0 ports, SD and microSD card slots, and a USB-C port.

The latter uses the USB 3.0 standard, and can be used as a passthrough for charging a laptop, connecting other USB-C devices, and outputting to an external monitor (using a separately purchased adapter).

The compact form factor plugs into the USB-C port directly, and it's designed to 'hug' the side of the laptop to keep things as streamlined as possible. This works well for the MacBook, but not so well for other laptops with USB-C ports, as it may block other ports. Laser would have done well to include a short cable to eliminate this issue.

Verdict

This adapter provides many of the ports your laptop may lack; however, it may cover some of the ports your laptop actually does have.



\$159 | WWW.AVAUSTRALIA.COM.AU

Minix Neo-C

One box to rule them all.

When Apple made the 'take no prisoners' decision to replace every port on the new MacBook with a single USB-C port, the logical expectation would have been a follow-up Apple accessory that offered all of the missing ports in a single USB-C connected box. That hasn't happened. Instead, users are expected to shell out hundreds of dollars' worth of adapters, and worse, play musical chairs with these adapters on the solo USB-C port.

Minix has come to the rescue with its excellent Neo-C dock, which offers two USB 3.0 ports, microSD and SD card readers, USB-C (which can be used for passthrough charging), HDMI (which outputs at up to 4K) and Gigabit Ethernet.

This one-cable solution makes the MacBook far more usable as a desktop workstation, and it's actually more practical than the usual native assortment of ports in that you only have to detach one cable whenever you leave your desk. Brilliant.

Verdict

This adapter brings back all the things Apple omitted from your laptop in a handy corded solution.



apc
RECOMMENDS

The 500GB version of the Samsung T3 Portable SSD offers the best bang for buck at \$299, and shows off the potential of USB-C with its blazingly fast 435MB/s read and 350MB/s write speeds.



USB-C quick tips

Get to know the ins, outs and secrets for using USB Type-C devices.

Docks are a lifesaver. Individual adapters are available that add the functionality that you'd be used to on a laptop, but smart buyers will look for docks that combine various ports into the one box.

Charging limits. Just because it's a USB-C charger, doesn't mean it can charge every USB-C device. Look at the maximum wattage it supports; the newest MacBook needs 29W — larger MacBooks need much more — which means chargers designed for mobile devices won't provide enough power for laptops.

Two cables included. During this in-between phase of USB-C implementation, you'll be able to get the most out of hard drives that include both USB-A and USB-C cables in the box.

Faster iPad charging. One of the perks of having to buy a USB-C to Lightning connector for iOS devices is that you can use it to plug an iPad into a MacBook power adapter and take advantage of significantly faster charging.

Hard drive speed limits. Don't expect crazy-fast speeds on a USB-C mechanical hard drive; it's incrementally faster than USB 3.0 at best due to its slower drive interface. You'll have to splurge on an SSD to reach those faster speeds.

USB-C CHARGING
DEVICES



\$75 | WWW.CABLEGEEK.COM.AU

Anker PowerPort+ 5

The power board for power users.

Ideal for families who fight over wall sockets, the Anker PowerPort+ 5 is capable of charging up to five devices simultaneously from the one outlet via four standard USB ports and a single USB-C port. The USB-C port is compatible with the newest power standard, USB Power Delivery, at up to 45 watts, which is enough to charge the new MacBook at full speed. The regular USB ports offer up to 2.4 amps per port, but these are limited to a total of 6 amps altogether; if you have two power-hungry tablets charging at the full 2.4 amps each on two of the ports, there's only 1.2 amps leftover for charging the other two devices. It's enough to power smartphones; it just means they won't charge at full speed.

As with any kind of power board, you should always be wary that poorly-made units run the risk frying your expensive gadgets. Not so with Anker, which is a reputable mobile accessories brand founded by a group of former Google employees.

Verdict

A high-quality accessory for charging all your USB-C devices simultaneously.



\$50 | WWW.BELKIN.COM/AU

Belkin USB-C Car Charger

The commuter's companion.

If you spend lots of time in the car, it's worth investing in a car charger to give your mobile device batteries a top-up – especially if you're using them for GPS navigation and/or music playback. While the Belkin USB-C Car Charger doesn't produce enough juice to charge a MacBook, it's capable of charging up to 15 watts – sufficient for a Samsung Tab Pro S, Google Pixel C and the growing assortment of smartphones shipping with USB-C connectors.

As well as the hard-wired USB-C cable – which is just long enough to reach into the backseat for smaller cars (an extra foot would've been handy for sedans) – there's a regular USB port for plugging in a second device to charge simultaneously.

Most car chargers are capped at 5 watts, which means this Belkin recharges 50% faster. Within half an hour, we were able to get a flat Google Pixel XL to 43%. Over the same time frame, on a 5W USB-A car charger, it only charged 28%.

Verdict

A super handy in-car charger for all your USB-C compatible devices; although, some extra length would've been great.



\$60 | WWW.BELKIN.COM/AU

Belkin USB-C Home Charger + USB-C to USB-C cable

For the flat batteries.

One of the downsides of having a USB-C device is that you won't find many other people who can lend you a charger if it goes flat unexpectedly. This is where having a second charger to hand is useful. The Belkin USB-C Home Charger comes with a 152cm USB-C cable that plugs into the USB-C port on the power adapter. Belkin also has a version that utilises a regular USB plug at one end and a USB-A port on the adapter; this means you'll be able to use the plug for charging older devices, but the downside is that it's limited to 10W power output.

Faster 15W charging on Belkin's USB-C to USB-C charger (left) paired with the fact that you get the flexibility of having an additional USB-C cable makes it the better option in our books – although it can't produce enough power to charge laptops, and it's capped at 480Mbps data transfer speeds. On the Google Pixel XL, it fully charged it from a flat battery in just under two hours.

Verdict

A wall adapter capable of recharging both USB-A and USB-C devices.





Staying power

Running a home server, NAS box or always-on PC? A low-cost uninterruptible power supply can save you from disastrous data loss and protect against power surges. Lindsay Handmer compares nine.

Blackouts are a rare occurrence for most of us, but for those running sensitive or important equipment, it can really ruin a day. Thankfully, an 'uninterruptible power supply' can be very affordable upgrade and provides more utility than you might expect. A UPS can keep your PC trucking through those momentary flickers or brownouts, it can automatically shut down a PC if power is lost, and the better models even have built-in surge protection. Some UPS include all sorts of management options, including remote reboots, to power monitoring.

A UPS is also useful for other appliances, not just PC gear, from providing stable power to AV equipment, to making sure your garage door opener still works in a blackout. A UPS doesn't come as just a mini-computer-style either – there are (relatively) slimline versions shaped like a chunky power board that can blend into the living room. To help compare, we've put 9 affordable uninterruptible power supplies to the test. We've included street prices for each, but make sure to shop around as the heavy nature of a UPS can increase postage costs.

"A UPS is also useful for other appliances, not just PC gear, from providing stable power to AV equipment, to making sure your garage door opener still works in a blackout."

HOW WE TESTED

We tested each UPS on a basic Core i5 Office PC (no discrete GPU) plus a 27-inch LCD monitor. The computer was set to play a looped video, and the power draw measured averaged out at 107 watts. The PC was run until the UPS lost power, and the result rounded to the nearest minute. It is important to remember that the UPS wattage rating is the maximum instantaneous power output – runtime is based on the battery capacity.

UNDERSTANDING UPS TECH

All the UPS units tested are what's known as 'line interactive', where 240V AC from the wall enters the UPS, is converted to lower voltage DC (charging the battery) and is then stepped back up to 240V for the output. If power is lost,

the battery can run the inverter for a short time. This allows the UPS to also compensate for a fluctuating input voltage. Most affordable UPS use a 'modified square wave' (also called 'simulated sine wave') inverter, as they are cheaper. While most electronics devices work just fine, some finicky ones need pure sine wave to closer replicate power from the wall. You can expect to pay at least two times as much for a pure sine wave UPS, so only buy one if you can confirm your equipment needs it.

UPS ratings are in VA and watts, but most appliances are only rated in watts. Many devices need a higher VA rating than a wattage rating, which is why a UPS will typically have a higher VA rating. If you have a specific device with a high VA rating, make sure to buy a UPS that can handle it.



950VA / 450W; 6x AU power sockets;
surge protection

\$135 | WWW.APC.COM



850VA / 510W; LCD readout;
8x socket surge protection

\$125 | WWW.CYBERPOWERSYSTEMS.COM



1200VA / 720W; 4x AU sockets;
surge protection

\$185 | WWW.CYBERPOWERSYSTEMS.COM

APC BX950U

A slightly lower power option.

Rather than the very common 1,000VA, 600W rating, the APC BX950U has a still high 950VA rating, coupled with a lower 480W output. This makes it ideal for those who need a high volt-amp rating, rather than pure wattage, such as for old equipment. Inside, the BX950U is a single 12V 9Ah SLA, coupled to the usual modified square wave inverter. The unit can accept input voltages of 150–280 and gives surge protection. It doesn't have an LCD – rather using a status LED and audible alarms. Switchover is 6–8ms, and noise is rated at 45dB. Round the back, the UPS has six standard power sockets, as well as telephone protection. In testing, the APC UPS had no problems taking over when power was cut, and ran our test PC for 21 minutes. Recharge time is 8 hours, and APC rates the battery longevity for 2–5 years. The unit includes a USB port, and allows auto shutdown and more advanced monitoring information via the easy-to-use PowerChute software.

Verdict

Very easy to set up and use, with quite good performance for the price.



CyberPower BR850ELCD

A brick-style power board UPS.

On the more affordable end of the UPS units tested, the CyberPower BR850 offers a 850VA, 510W rating for \$139. The BRICs series is also available in other sizes, too – 700VA, 1000VA and 1200VA. Like most units, the BR850 can adjust for varying voltage input, and outputs a simulated sine wave. With a chunky power board-style design, the UPS features eight Australian 240V sockets to handle multiple devices – only four have battery backup, but along with a phone or lan connection, all feature 125 joule surge protection. While the unit has the usual audible alarms and LED indicators, it also has a basic LCD for easy monitoring. Inside is a 12V 9Ah SLA, which is set up to be easily user hot-swappable. In testing, the UPS never failed to switch when power was lost, and kept our test PC ticking for 24 minutes. The unit includes a USB port, and manages the UPS, including auto shutdown, via the fairly well featured PowerPanel software.

Verdict

An excellent range of features coupled with top notch performance.



CyberPower VALUE1200ELCD

A UPS for those with higher power needs.

As with many of the competition, the CyberPower Value Series covers a range of UPS sizes. We tested the 1,200VA/720W model, but you can also get a 1,500VA/900W and 2,200VA/1320W version. The UPS uses two 12V 7Ah batteries, coupled to the usual simulated sine wave output. The unit can accept 160–280V, and has a nice low switchover time of 4ms. On the rear, it sports four standard AU 240V sockets, as well as LAN, all of which include surge protection. The UPS is large enough to need a small fan, and is audible but not annoying when running over a desk. During testing, the UPS kept our test PC running for 40 minutes, and charged back to full capacity in the usual 8 hours. The CyberPower UPS includes an LCD to make it easy to see the status at a glance, but also has a USB port for computer connection. The included PowerPanel is easy to use, and gives access to management info, and can set auto shutdowns.

Verdict

A slightly higher power UPS that covers all the basics without going overboard on price.





650VA / 420W; pure sine wave inverter; power monitoring

\$335 | WWW.EATONCORP.COM.AU

Eaton 5P650AU

A high-end option.

With a very normal 650VA/420W rating, you could be forgiven for wondering why the Eaton 5P650AU costs twice as much as some of the similarly-rated competition. The Eaton is aimed at those who need some very specific features and in-depth software management. The UPS has a pure sine wave output (compared to the typical modified square wave), which is needed for some sensitive equipment, and can even have the output voltage set. It also offers very high efficiency and power use tracking, important to reduce ongoing costs. While it can be used at home, the 5P650AU has business-focused features, including integration with software such as VMWare, and the ability to remotely control specific outputs to reboot equipment. It's available in rack or tower form, has a handy LCD and both 3x IEC outputs, as well as dual AU sockets. In testing, it happily kept our PC running for 23 minutes, and never failed to switch over at loss of power.

Verdict

A high-end UPS for those needing efficient, in-depth control and monitoring.



1,000VA / 600W; 4x IEC outputs; USB connection

\$145 | WWW.DELTAWW.COM

Delta VX Series

Available in 600, 1,000 and 1,500VA models.

While we tested the Delta VX1000VA for \$145, the VX600 is just \$69, and the larger VX1500 costs \$175. The UPS features a 600W rating, with dual 12V, 7Ah SLA batteries inside, and a modified square wave output. It's a tower-style device, measuring in at 32 x 18.2 x 1.3cm. Connectivity is provided by four IEC sockets on the rear, and cables are included to make plugging up to normal 240 connects easy. All connections are backed by the UPS, which handles voltages of 170-280, as well as surge protection. The VX series has a touchscreen LCD displaying info such as capacity, load level and status. In testing, it happily ran our test PC for 41 mins, and had no issues switching over when power was lost. The UPS is fairly quiet and isn't easily heard under a desk. Recharge time is around 8 hours, and no extra protection is included for telephones. It includes a USB connection and easy-to-use ViewPower software for automatic shutdowns and monitoring.

Verdict

Excellent specs and performance considering the affordable price.



600VA 300W; UPS plugs: 3; auto PC shutdown

\$139 | WWW.JAYCAR.COM.AU

Jaycar Line Interactive UPS

A small and cheaper offering.

Built like an oversize plugboard, rather than a mini tower, the Jaycar MP5224 has a 600VA, 300W rating. Inside is a single 12V 7Ah battery, which runs through a modified sine wave inverter. The unit features six sockets, with three driven from the mains and three offering UPS functionality. All plugs are surge protected, with the same protection offered for a telephone via RJ12 sockets. The UPS is rated for a 6ms switch-over time, and under 45dB noise at 1m. The MP5224 is small as UPSes go, and is ideal for one PC or AV equipment. In testing, we managed a respectable 14 minutes of runtime, and had no issues with the unit kicking in when the mains was disconnected. The Jaycar UPS has a USB connection and includes basic but functional auto PC shutdown for Windows and Linux. The unit was slightly noisier than average, but considering the relatively cheap price for the rating, it's not too bad. The UPS measures in at 28 x 18.5 x 9.5cm, and the battery is user replaceable.

Verdict

With a respectable performance for the asking price, this is a fairly good low-end option.



UPS quick tips

Learn how to get rapidly set up and running with a new UPS.

Uninterruptable
YouTube

If possible, run your modem/router via your UPS, so that even after your PC has automatically shut down, battery Wi-Fi devices will still have internet access.

Battery changes

UPS batteries last between 2–5 years depending on use, so having a model that makes it easy to change them yourself is ideal.

A noisy noise annoys
everyone

UPSes create a mild buzz when in use, as well as fan noise for more powerful models, so they are best installed somewhere out of the way — just remember they still need airflow.

Interrupted power
supply

UPSes are generally slow to charge, so if you experience frequent blackouts, a model with a larger capacity is ideal.

Software package

Check the software package before buying — USB connections mean auto shutdown at a minimum, but many UPSes have many more advanced features.

Surge protection

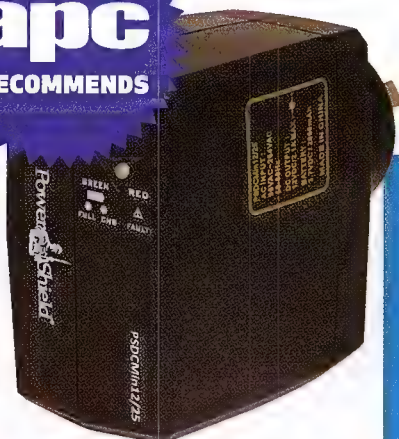
Most UPS include built-in surge protection to help protect your gear. The better ones will even have extra surge protected (but not UPS protected) power connectors.

“UPS batteries last between 2–5 years depending on use.”



TABLE HEADLINE

UPS	APC BX950U	CYBERPOWER BR850ELCD	CYBERPOWER VALUE1200ELCD	DELTA DLT-VX1000	EATON SP650AU	JAYCAR MP5224	POWERSHIELD DC MINI	POWERSHIELD SAFEGUARD	UPSÖNIC ORION 750
PRICE	\$135	\$139	\$184	\$145	\$335	\$139	\$95	\$109	\$139
RATING	950VA / 480W	850VA / 510W	1,200VA / 720W	1,000VA / 600W	650VA / 420W	600VA / 300W	18W DC	750VA / 450W	750VA / 450W
RUN TIME	21	24	40	41	23	14	133	23	21
UPS CONNECTIONS	6x AU SOCKET	4x AU SOCKET	4x AU SOCKET	4x IEC + CABLES	3x IEC, 2x AU SOCKET	3x AU SOCKET	12V MULTIPLUG	3x AU SOCKET	3x AU SOCKET
BATTERY	12V 9AH SLA	12V 9AH SLA	2x 12V 7AH	2x 12V 7AH SLA	12V 9AH SLA	12V 7AH SLA	3.7V 2,600mAh LI-ION	12V 9AH SLA	12V 9AH SLA
WH	108	108	168	168	108	84	9.62	108	108
RECHARGE TIME	8 HOURS	8 HOURS	8 HOURS	8 HOURS	4 HOURS	8 HOURS	3 HOURS	4 HOURS	4 HOURS
LCD	NO	YES	YES	YES	YES	NO	NO	NO	NO
NOISE	45 DB	NOT GIVEN	50 DB	< 40 DB	< 40 DB	< 45 DB	NOT GIVEN	< 5 DB	< 40 DB
OUTPUT WAVEFORM	SIMULATED SINE WAVE	SIMULATED SINE WAVE	SIMULATED SINE WAVE	SIMULATED SINE WAVE	PURE SINEWAVE	SIMULATED SINE WAVE	DC	SIMULATED SINE WAVE	SIMULATED SINE WAVE
INPUT VOLTAGE	150–280V	170–190V	160–280V	170–280V	150–294V	184–276V	90–265V	177–290V	170–285V
SURGE PROTECTED	YES	YES	YES	YES	NO	YES	YES	YES	YES
USB	YES	YES	YES	YES	YES	YES	NO	YES	YES
SWITCH OVER TIME	6–8MS	4MS	4MS	NOT GIVEN	NOT GIVEN	< 6MS	N/A	6MS	2–6MS
DIMENSIONS CM	33.6 x 21.5 x 13	28.8 x 16.6 x 11.8	32.6 x 18 x 14	13 x 32 x 18.2	34.5 x 23 x 15	28 x 18.5 x 9.5	7.8 x 7.4 x 4.2	29.2 x 19.9 x 9.1	29.2 x 19.9 x 9.9



12V 1.5A (18W); Universal 12 plugs;
surge protection

\$95 | WWW.POWERSHIELD.COM.AU

PowerShield DC Mini

A plugpack UPS for 12V devices.

While just about any device can be plugged into a UPS, it's not a very efficient way to handle small power users such as a modem or router. The PowerShield DC Mini takes a different approach – just aiming to provide UPS functionality for 12V devices. The advantages are better efficiency, a size not much larger than a normal plugpack, and a long runtime. The DC Mini can output 12V 1.5A (18W), which will run most routers, but not some of the larger power-hungry models. It uses a range of universal tips (including Molex), so will work with most models. Inside, it has a 3.7V, 2,600mAh battery, which, in our testing, could run a router (5W) for 2 hours and 13 minutes. This means that, in a blackout, your internet and Wi-Fi will keep working just fine. The unit fully charges in about 3 hours, so can handle multiple power cuts in a row. It also has surge protection built-in, but, of course, does not connect to a PC.

Verdict

A compact and efficient way to give UPS functionality to 12V devices.



750VA / 450W; 460 Joule 11,000A
surge protection

\$109 | WWW.POWERSHIELD.COM.AU

PowerShield SafeGuard

Protect your sensitive equipment.

Rather than being built in a mini tower, the PowerShield SafeGuard uses the oversize powerboard approach, which can even be wall-mounted. The UPS offers a decent 750VA, 450W rating, and outputs the usual simulated sine wave. The unit uses a single 12V 9Ah battery, which can actually be hot-swapped very easily. While the PowerShield UPS has six AU sockets, only half offer UPS functionality. All the outputs have a class-leading 460 Joule 11,000A surge protection, which is also extended to a phone or LAN connection. The UPS does not have an LCD – instead using LEDs and audible alarms. The UPS happily ran our test PC for 23 minutes, is almost silent in operation and can fast charge back to 90% capacity in 4 hours.

The SafeGuard also includes a USB connection, and uses the excellent PowerShield NetGuard software. While not as user friendly as some of the competition, there are loads of configuration and monitoring options.

Verdict

Great performance and surge protection in a very compact, affordable package. Supports Windows, Mac, Linux and Unix!



750VA / 450W; 4 hour recharge;
surge protection

\$139 | WWW.UPSONIC.COM.AU

Upsonic Orion 750

Ideal for home or small office use.

Built using the brick style form factor, the Upsonic Orion 750 is easy to hide under a desk, or even wall mount, and measures in at 29.2 x 19.9 x 9.9cm. The UPS offers a 750VA / 450W rating, with the usual simulated square wave output. Three of the five AU power sockets provide UPS functionality, while all (plus LAN) are surge protected. Inside, the Orion has a fairly easily user swapped 12V 9Ah SLA battery. It can handle an input from 170–285 volts, while the output is rated to +10% of 230VAC. Switch-over time is under 6ms, and the UPS is quiet in operation. During testing, it never failed to switch during loss of power, and ran our load PC for 21 minutes. Charging time is quite quick, and it can be back up to 90% charge in around 4 hours. The Orion includes a USB port for connecting to a computer and enabling auto shutdowns. The included software is quite functional, but a little basic compared to the slicker competition.

Verdict

A compact form factor and affordable price, but lacks a little polish.



Recharge on the run!

Always running out of battery? Lindsay Handmer test 10 portable power banks that'll let you recharge your gadgets — and even laptops — while you're on the move.

In a world of gadgets, power banks are a great way to extend battery life. While they come in a range of sizes from models that can fit on a keyring, to those able to power a laptop or start a car, we've aimed for a middle ground. As the battery tech improves, 10,000mAh (or so) battery banks are highly portable, yet can still top up a phone multiple times. While we firmly believe one should be in every bag just in case, they are also worth it for occasional use, such long plane or public transport rides, or going camping.

Make sure not to leave a power bank in a hot vehicle during summer, as the high temperatures can reduce the life of the cells. It's worth noting that there are loads of poor-quality power banks available on eBay which do not meet their claimed capacities or current outputs. To help weed out the undesirables, we've tested 10 power banks from known brands and compared the feature sets.

KEY FEATURES

Every power bank will suit different uses. Those who expect to be away from the grid for a longer period should consider capacities over 10,000mAh, and conversely, there are plenty of small units as well. Having two or more USB ports is ideal, but make sure at least one is rated for 2A or more of current, as this is needed to charge a tablet in a reasonable time. Qualcomm's Quick Charge tech is a great way to charge your phone in a hurry, but it's only supported by some power banks. To reduce clutter or lost cables, some power banks integrate a connector into the device itself. Almost all power banks will have a basic LED battery level meter, but the better ones give an actual numerical display for increased accuracy. Some power banks include other handy features, such as a built-in LED torch, waterproofing, warranty covering the charged devices.

CAPACITY RATINGS

Typically given as mAh (and sometimes Wh), power bank ratings are for the battery cells inside. The problem is that, by the time the voltage from the battery is converted to transfer over USB, then converted back to charge your device's battery, some is lost. So while the power bank might be rated at 10,000mAh, only 9,000mAh will actually make it into your phone. We can't test the conversion efficiency of every phone, but we can test the power banks. We connect each to 10W load and USB power meter, and measure how much passes through. Due to normal losses, we don't expect to see 100% — closer to 95% is normal and anything above that is excellent. But manufacturers who use better-quality battery cells, or understate the capacity, can end up with more than 100% of the rated capacity available in the real world. While not the be all and end all, it's a good way to weed out underperforming battery banks, and gauge the quality of the cells and circuitry used.



10,000mAh; Qualcomm Quick Charge 3.0;
10 x 6.3 x 2.2cm; 198g

\$64 | WWW.SOBRE.COM.AU

Anker PowerCore Speed 10,000mAh

A high tech power bank.

For those who want the latest cutting-edge features, the Anker PowerCore Speed is equipped with Qualcomm Quick Charge 3.0. With a compatible phone and cable (probably best to take a quick look at qualcomm.com), it's possible to charge up to 4x faster, but in our experience, 2x is typical in the real world.

The unit can output 2.4A at 8-10V, and 2A at 10-12V, but itself only charges at a normal 5V 2A rate via micro USB and does not support passthrough charging. For those without Quick Charge, the Anker power bank will still output up to 3A at 5V from the single USB port.

In our testing (standard charge rates), the Anker PowerCore Speed gave an excellent 99% of the rated capacity and happily charged our QC test phone.

While the manufacturer does boast Temperature Control technology to ensure the charger remains relatively cool in all

conditions, at high charge rates (especially in a bag), heat can be an issue, so the PowerCore Speed will throttle back if the temperature gets too high.

The PowerCore also includes PowerIQ tech which claims to be able to automatically identify a connected device in order to provide it the best charge.

The power bank itself is clad in tough plastic, and measures a very compact 10 x 6.3 x 2.2cm, and a featherweight 198 grams, making it perfect for slipping into a bag to take with you on your travels.

While it may not look as premium as the Belkin (right), Anker is a quality brand for mobile accessories, making this well worth the price.

Verdict

Well worth the price for faster charging, but only if you have a compatible phone.





10,000mAh; Micro-USB, USB-C, Lightning;
\$2,500 Connected Equipment Warranty

\$99 | WWW.BELKIN.COM/AU

Belkin Mixit Power Rockstar

Available in a range of specs.

While not the cheapest power bank on the market by any means, the Belkin Mixit Power Rockstar range has a bundle of features not seen elsewhere.

The power bank itself is available in 10,000mAh and 6,600mAh capacities, and comes in either grey or gold colour schemes. The Power Rockstar is clad in aluminium, giving it a very high-quality feel, and includes a handy mini cable (available as micro USB, with either USB-C or Lightning), held in place by a magnet, which is a nice little design touch — helping to keep those cables close while on the go. All the variants still use micro USB to charge, though.

The unit has dual USB ports, each capable of outputting 2.4A, as well as an LED battery level indicator.

In testing, the power bank happily output the rated current, and an excellent 101% of the 10,000mAh

capacity — reaching a peak of 10,100mAh. It also supports passthrough charging, but not any quick charge tech. On a full tank, the 6,600mAh version of the Power Rockstar is able to recharge your phone three times before needing to be plugged in itself. The 10,000mAh version boasts the ability to charge your phone four times, or your tablet twice.

Belkin also offers a \$2,500 connected equipment warranty, covering your phone or tablet in the extremely unlikely event the power bank damages it.

The unit is quite compact, measuring 13 x 8 x 2cm and weighing 320 grams.

Verdict

Expensive, but well worth the extra features and peace of mind.



10,000mAh; 3x USB, 2A, 1A, 1A; LED Lamp;
9.5 x 3.5 x 20cm; 284g

\$49 | WWW.COMSOL.COM/AU

Comsol TPP10BK Power Bank

Available exclusively from Officeworks.

While shopping around online is a great way to get the best price, the Comsol TPP10BK bank is an OfficeWorks exclusive, meaning it'll be one of the easiest to find in if you prefer the convenience (and safety) of shopping in the traditional brick-and-mortar way. (OfficeWorks has around 160 stores across the country, so there should be one nearby that stocks this particular bank.)

The Comsol TPP10BK has a 10,000mAh capacity, a soft touch plastic body and features three USB ports. One is rated for 2A fast charging, while the other two can output 1A each. While it would have been nice to see at least two ports handling 2A+, having the two extra 1A connections is very handy for charging multiple lower-current devices at once — especially useful if you're being forced to share this device with another member of your digitally savvy family.

Like most power banks, the Comsol charges up via micro-USB, and includes a short cable in the box. Another feature the Comsol sports is a built-in "emergency torch" with a twist — rather than an exposed LED, it lights up the entire translucent white end of the power bank as a lamp, and is therefore great for use when camping.

In testing, we pulled a solid 97% of the rated capacity — above what we expected considering efficiency losses.

It's not as pocket-sized as others in this roundup, coming in at 9.5 x 3.5 x 20cm, but its extra features more than make up for any lack of portability.

Verdict

Extra USB ports and a very bright lamp — what's not to love?





10,000mAh; 2x USB, 2A, 2A;
Digital Capacity Display; 14.2 x 1.5 x 7.2cm; 218g

\$99 | WWW.CYGNETT.COM

Cygnett ChargeUp Digital

Charge a smartphone up to seven times.

With a large 10,000mAh capacity battery, the Cygnett ChargeUp Digital keeps your devices going for days. Clad in soft touch plastic, the power bank feels tough and won't scratch easily. It's also a surprisingly thin model – just 1.5cm thick, but tall at 14.2cm, and 7.2cm wide. The result is a unit that is a very similar size to a smartphone, and which fits easily into a bag or pocket. It's also comparatively quite light at 218 grams, which all adds up to a super portable package.

The ChargeUp has two USB ports that can split a total of 4A current, and charges via micro-USB (with a cable included). The power bank also stands out with a digital display that shows the remaining charge, making it easy to judge exactly how much is left – a feature not common in other models.

Claiming to be able to charge your phone up to

seven times – it's also compatible with tablets and cameras – this Cygnett power bank paints an enticing picture.

In testing, the unit happily output the rated current, as well as an excellent 98% of the claimed capacity.

However, there are a couple of caveats. With a price of around \$99, the Cygnett ChargeUp Digital is not the cheapest power bank for the capacity, and we wish it included Qualcomm Quick Charge.

There's also a 6,000mAh model available for around the \$70 mark.

Verdict

Very portable and decent features, but you do pay a bit of a price premium.



10,400mAh; 2x USB, 2.1A, 1A; IP67 Waterproof;
14.5 x 7.5 x 2.5cm; 300g

\$109 | WWW.JAYCAR.COM.AU

Jaycar Waterproof Power Bank

For those who love the great outdoors.

While most power banks are pretty tough, even just a light accidental dunking can put them out of commission permanently. This Jaycar power bank adds a layer of protection, with a double-moulded housing that's IP67 waterproof, dustproof and shockproof. It's rated to handle a fresh-water swim of up to 1m deep for 30 minutes, and will shrug off rain without a care. Considering many phones are now also waterproof, or at least water resistant, it's a pretty handy feature – just make sure to dry the USB cable ends before charging.

The Jaycar power bank has a 10,400mAh capacity, and in testing, we found that an adequate 96% of that is available for charging.

The unit has dual USB ports – one that can fast charge up to 2.1A, while the other outputs 1A. The power bank charges up via standard micro-USB at a 2A rate – going from empty to

full in about 5.5 hours. It also has a four-LED power level indicator but sadly no torch, like the Comsol back over the page. It does, however, offer over-charge, short-circuit and over-heat protection, similar to that in the Anker power bank (see page 68).

Despite the extra protection, the power bank is still a fairly slim 14.5 x 7.5 x 2.5cm and weighs 300 grams, making it well and truly portable, although perhaps not quite comfortably slipped into a pocket.

Its design, too, is also likely to be an acquired taste, looking a bit more like an old-school GPS than a modern smartphone accessory.

Verdict

A great power bank for venturing off the beaten track, albeit for a hefty asking price.





10,400mAh; 2x USB, 2.1A, 1A; 10 x 7.5 x 2.5cm; 231.3g

\$29 | WWW.KOGAN.COM/AU

Kogan Universal 10,400mAh Power Bank

Affordable charging on the go.

At the time of testing, this well-specced unit cost just \$29 and including free shipping, making the Kogan Universal power bank one of the cheapest units we tested. (We'd note, however, that this was during their EOFY sale, so that total cost may vary – particularly the free shipping element.) It's got a large 10,400mAh capacity, as well as dual USB outputs, and micro-USB charging. It can output up to 2.1A from the bottom port, but the second port is limited to 1A.

The power bank is the classic minimalistic brick design, wrapped in tough high-impact white plastic, and the build quality is solid. The unit measures in at 10cm high, 7.5cm wide and 2.5cm thick, and is a reasonably lightweight 231.3 grams.

A micro-USB cable is included in the box, and the power bank has the usual four-LED indicator lights to show the power bank's

remaining battery capacity.

During testing, we managed to draw 94% of the rated capacity, which doesn't sound that great when looking at the other power banks in this roundup, but it's actually a great result considering the low asking price.

Those looking to charge multiple power-hungry devices (such as tablets or USB-C charging laptops) should look elsewhere, but if you just want a large capacity and decent quality at a low price, then the Kogan Universal power bank is hard to beat... even if you do end up having to pay a few dollars more for shipping.

Verdict

An affordable power bank without unnecessary bells and whistles.



10,000 mAh; 2x USB, 2.1A, 1A; Multiheaded USB Adaptor; 12 x 7 x 2cm; 285g

\$39 | WWW.LASERCO.COM.AU

Laser Power Bank 10000

Taste the rainbow.

Power banks can be a boring lot, with endless blacks, greys and whites (with the exception of the orange styling of the Jaycar, left). But not the Laser power banks, which come in startlingly bright colours – yellow, pink, blue and green.

The delicate internals are protected with a plastic shell which is solid, but not quite as slick as the competition – something which is not entirely due to the colour choices, either.

We tested the 10,000mAh model, but there are also 4,400mAh and 2,200mAh versions. The small capacities only offer a single USB port, but the larger model has two. As is typical with power banks, one port is rated for 2A, while the other can only handle a slower 1A rate, with no sharing between them.

In testing, the Laser performed well, outputting 94% of the rated capacity. Again, this might seem lower than the others tested

here, but when you take the price into consideration, it's not too shabby in terms of performance-to-price.

The unit is charged up via micro USB, but can be a little slow, and sadly does not support passthrough charging. The unit has four LED lights to indicate the remaining battery level, and comes with a multi-headed USB charge cable, offering micro-USB, Lightning and the old 30-pin Apple connector.

The power bank measures in at a compact 12 x 7 x 2cm and weighs 285 grams.

Verdict

An affordable and colourful, if overall unremarkable, power bank.





20,100mAh; 2x USB, 2.4A (3A total);
6.1 x 2.2 x 15cm; 344g

\$69 | WWW.TP-LINK.COM.AU

TP-Link Ally Series

A seriously high capacity option.

While most power banks come in different sizes, the TP-Link Ally series is aimed at those who need more than your average amount of capacity. Blasting the opposition out of the park, the Ally power banks offer 20,100mAh and 15,600mAh models. The two versions are identical in size at 15 x 6.1 x 2.2cm, and both weigh 344g, but the 20,100mAh model (tested here) has higher capacity LG cells to give it the extra grunt.

The 20,100mAh power bank has dual USB output ports that can handle up to 2.4A each, but only 3A max across both. For such a large-capacity power bank, this fact is a bit disappointing, as it means it can only fast-charge one device at a time.

Self-charge is handled by micro USB, at up to 2.4A – so it takes about 6 hours or so to fill back up once drained.

On the plus side, during testing, we drew a very

decent 97% of the 20,100mAh capacity – no doubt thanks in part to the high-quality LG cells used.

The Ally series uses a large six-LED array to show capacity (which is triggered by a button press), giving increased accuracy. It also includes a handy LED torch.

Looking at its specs, it's clear to see that this is not a device for someone who needs to recharge their multiple devices at once, rather a single device (even an appropriate small USB-C charging laptop) or a couple in alternating fashion. If this sounds like you, this is a solid unit, but we would have liked to have seen more flexibility to go with that extra power.

Verdict

Large capacity and solid performance let down by a 3A total charge limit.



10,000mAh; Qualcomm Quick Charge 2.0; USB-C
Input + Adapter; 13 x 7.5 x 1.2cm; 225g

\$32 | WWW.MI.COM/EN

Xiaomi Power Bank Pro

Compact yet powerful.

For those with a compatible phone, the Mi Power Bank Pro offers super-fast Qualcomm Quick Charge 2.0 tech and a large 10,000mAh capacity. It also supports fast charging on both the input and output. That is important, because it means that if you have a Qualcomm Quick Charge capable wall charger, the battery bank itself can be juiced up a lot faster.

It supports passthrough charging as well, so the power bank can be left between your charger and phone (or other device) without loss of charging speed. It will also handle charging USB-C laptops, and can charge itself from other USB-C devices. The power bank uses a USB-C input (and single normal Type-A output) but comes with a micro USB cable and USB-C adapter.

In testing, we managed to pull an impressive 99% of the rated capacity and up to 2.1A at 5V output.

The Xiaomi power bank is very compact considering the capacity, and slim enough even for a pocket. It measures in at 13 x 7.5 x 1.2cm and weighs a svelte 225 grams.

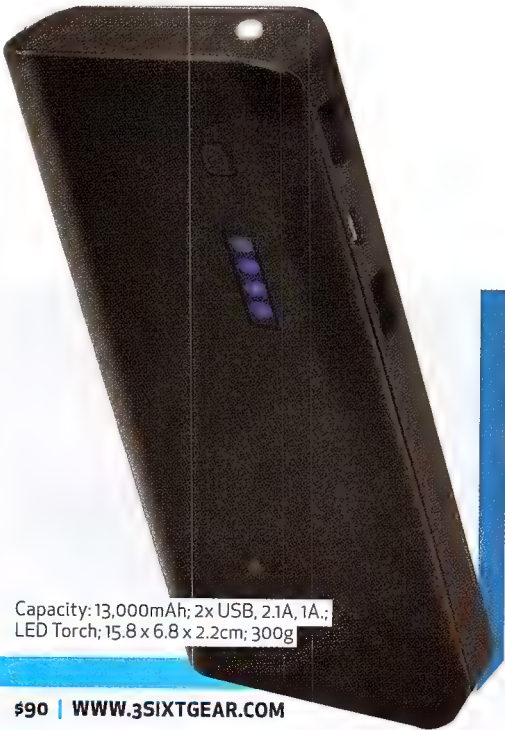
The Pro also offers low-power charging for Bluetooth headsets and fitness bands, making this a really versatile and cheap power bank that can service pretty much all your portable devices.

Xiaomi also offers a few other capacity sizes in its non-Pro series, including 5,000mAh, 16,000mAh and a whopping great 20,000mAh version.

Verdict

Excellent capacity and features, especially considering the affordable price.





Capacity: 13,000mAh; 2x USB, 2.1A, 1A.; LED Torch; 15.8 x 6.8 x 2.2cm; 300g

\$90 | WWW.3SIXTGEAR.COM

3SIXT JetPak

A little extra capacity.

With a rating of 13,000mAh, the 3SIXT JetPak is significantly larger than the typical 10,000mAh power bank. In capacity that is, as it still measures at a fairly slim 15.8 x 6.8 x 2.2cm and weighs 300 grams.

The JetPak has dual USB ports – one rated at 2.1A, and the other at 1A, as well as a micro-USB socket for charging its internal battery back up. Unlike many power banks, the JetPak places the USB ports on the side, rather than the end. This is pretty handy when charging in a handbag or similar horizontal orientation, but equally can be frustrating if trying to charge while the unit is in a pocket. So... each to their own, we suppose.

The JetPak is wrapped in rubberised plastic, and includes a four-LED battery level indicator on the side. In a move we love, it also has a high brightness LED for use as a

torch – activated by double clicking the power button, meaning this device can also serve you very well while camping.

In testing, the JetPak outputted 95% of its rated capacity, and had no issue supplying up to 2.1A.

However, despite that extra capacity, this unit simply didn't live up to its price premium. It provided decent performance but nothing to set it apart from the others in the roundup.

Verdict

Decent performance but an above average price despite the extra capacity.



TABLE HEADLINE

	ANKER POWERCORE SPEED 10,000mAh	BELKIN MIXIT POWER ROCKSTAR	COMSOL TPPI0BK POWER BANK	CYGNETT CHARGEUP DIGITAL	JAYCAR WATERPROOF POWER BANK	KOGAN UNIVERSAL 10400 MAH POWER BANK	LASER POWER BANK 10000	TP-LINK ALLY SERIES	XIAOMI POWER BANK PRO	3SIXT JETPAK
PRICE	\$64	\$99	\$49	\$99	\$109	\$29	\$39	\$69	\$59	\$90
RATED CAPACITY mAh	10,000	10,000	10,000	10,000	10,400	10,400	10,000	20,100	10,000	13,000
REAL WORLD CAPACITY mAh	9,889	10,100	9,751	9,812	9,991	9,751	9,387	19,511	9,931	12,326
% RATED CAPACITY	99	101	97	98	96	94	94	97	99	95
MAH PER DOLLAR	155	102	199	99	92	336	241	283	168	137
IPHONE 7 CHARGES (1,960mAh)	4.8	4.9	4.7	4.8	4.9	4.7	4.6	9.5	4.8	6.0
GOOGLE PIXEL CHARGES (2,770mAh)	3.4	3.5	3.4	3.4	3.4	3.4	3.2	6.7	3.4	4.2
OUTPUT MAX	3A (5V)	2.4A, 2.4A	2A, 1A, 1A	2A, 2A	2.1A, 1A	2.1A, 1A	2A, 2.1A	2.4A, 1A	2A (5V)	2.1A, 1A
QUALCOMM QUICKCHARGE	QC 3.0	NO	NO	NO	NO	NO	NO	NO	QC 2.0	NO
PASSTHROUGH CHARGING	NO	YES	YES	YES	YES	YES	NO	YES	YES	YES
USB PORTS	1	2	3	2	2	2	2	2	1	2
DIMENSIONS	10 x 6.3 x 2.2cm	13 x 8 x 2cm	15 x 6.3 x 2.2cm	14.2 x 7.2 x 1.5cm	12.2 x 7.8 x 2.2cm	10 x 7.5 x 2.5mm	12 x 7 x 2cm	15 x 6.1 x 2.2cm	13 x 7.5 x 1.2cm	15.9 x 6.8 x 2.2cm
WEIGHT (GRAMS)	198	320	284	218	293	231	268	344	225	300

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

STORAGE

LIMIT STORAGE SPACE FOR SPECIFIC USERS

Our household uses a shared Windows PC, with each user having a separate account. One of my family members keeps filling up the hard drive — is there some way to put a limit on that?

Don Taylor

The answer to your dilemma lies with the Disk Quotas tool, which allows you to specify the maximum amount of storage space each user has on each attached drive. Here's how to set it up.

1 First, you need individually enable the disk quotas feature for each hard drive. Open 'File Explorer > This PC', right-click the drive in question and choose 'Properties > Quota' tab. Click 'Show Quota Settings' and start by ticking 'Enable quota management'.

Next, we'll set some universal limits using the same tab. Tick 'Deny disk space to users exceeding quota limit' and select 'Limit disk space to'. Set your chosen limit (probably in GB) – we also recommend setting a warning limit, around 10–20% less than the limit you've picked.

3 To set the limits for any individual users, simply leave 'Do not limit disk usage' selected and click 'Quota Entries' instead. Then select 'Quota > New Quota Entry'. Click Advanced followed by 'Find Now' to list all available users.

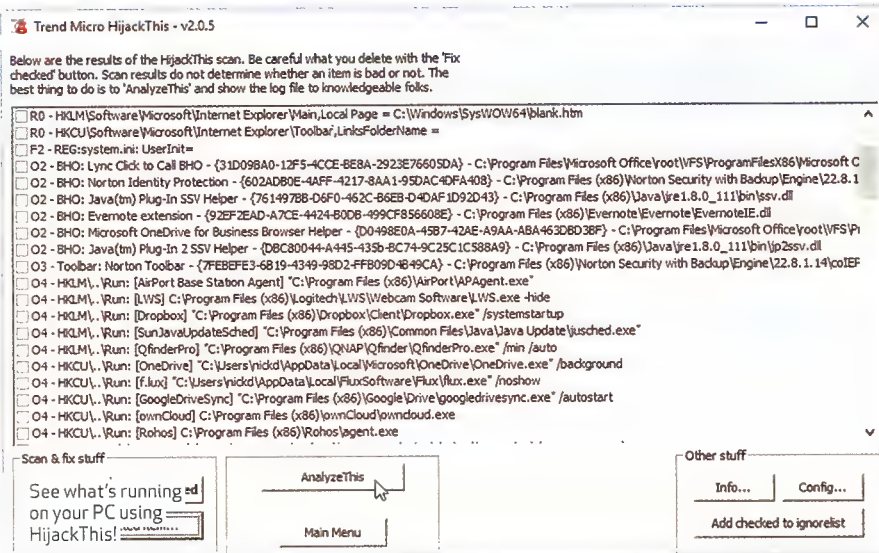
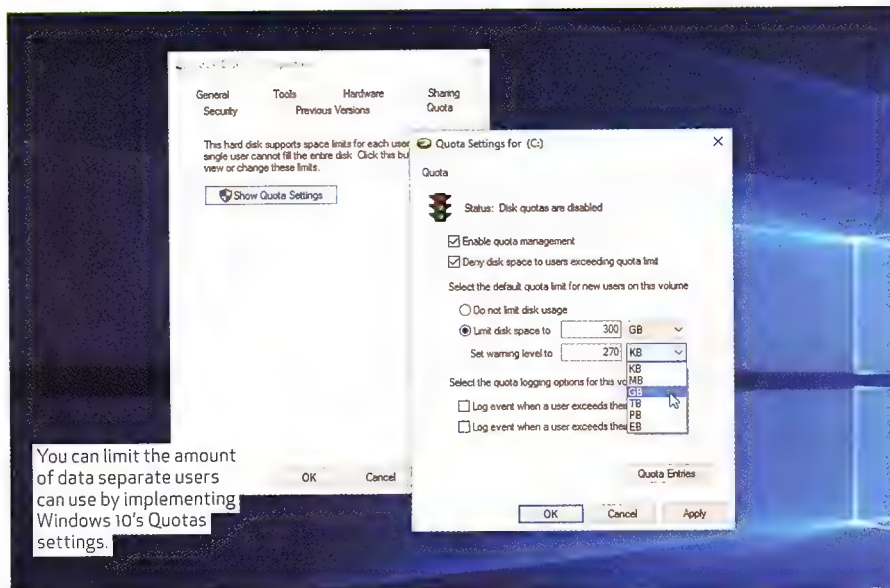
 Select a name from the list (they must have a user on your PC) and click OK twice. Set their quota and warning limits as required, then repeat for other users you wish to apply limits to. Once done, close the window and click OK twice.

Nick Peers

WINDOWS

BLUE-SCREEN ERRORS PLAGUING NEW WINDOWS INSTALL

For a long time now, whenever I start or restart my Dell XPS 8700 PC (running Windows 10), I get an immediate BSOD referring to NETIO.SYS and with the following Stop Code: 'Kmode Exception Not Handled'. The computer then attempts



to fix the problem and after several reboots, Windows will load. I've come across the same error on another PC we own, but this only occurred once. I've tried rolling back to a system image and numerous clean reinstalls, all with no success. Hopefully you can save me the cost of a new PC!

Jim Thomas

The netio.sys file is a generic Windows one, so there were no clues there. We

asked Jim to send us his HijackThis! log to see what was running on his PC – he revealed that AVG Internet Security was installed, and our Google searches for the netio.sys error did turn up one that was linked to AVG. Jim dutifully uninstalled the program and the BSOD errors immediately ceased. We dug a little deeper and found numerous references to AVG causing this kind of error, so Jim has subsequently switched antivirus

products – Avira (www.avira.com) is one that currently scores highly for those looking for free protection. Nick Peers

SECURITY

HOW TO ENCRYPT A USB FLASH DRIVE?

I've recently bought a new laptop and want to password-protect the USB drives that I'm going to use with it. However, I can't seem to find BitLocker on my laptop (which is running Windows 10). Is there a good alternative? Any advice would be gratefully received!

John Hollingsworth

BitLocker only comes with Windows 10 Pro, but thankfully there are plenty of alternatives out there. Assuming you're looking for something free, then DiskCryptor (diskcryptor.net) would enable you to encrypt the entire flash drive, although it can be tricky to install and set up. In most cases, you're only looking to encrypt particularly sensitive files, in which case Rohos Mini Drive (www.rohos.com) would offer a more user-friendly alternative. The free version allows you to create a hidden and encrypted storage container up to 8GB in size, which should be ample for most people's needs, and it doesn't delete existing files on the drive either.

Graham Barlow

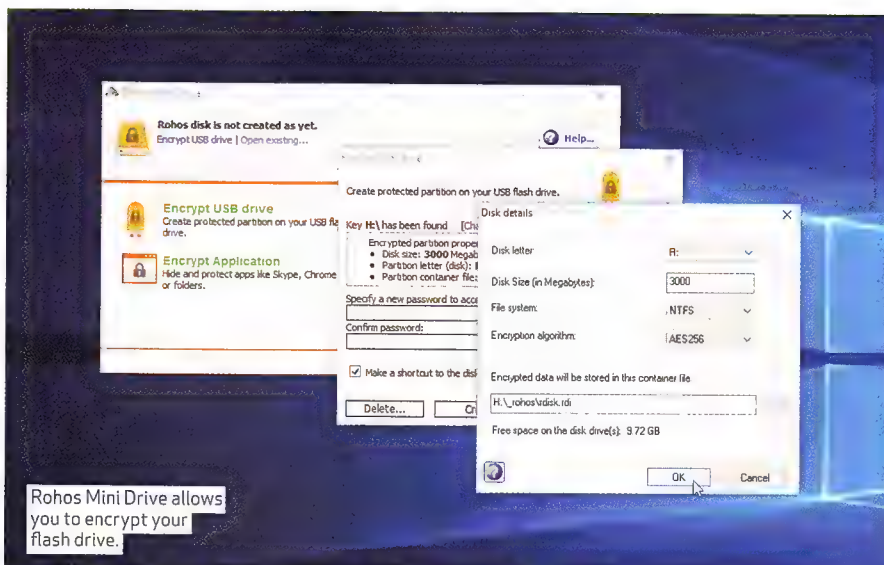
MAC

MAC WON'T WAKE UP PROPERLY

My 21.5-inch iMac 21.5 (Late 2012) running OS X 10.11.4 has started freezing when I try to wake it from sleep. On entering the start of my password, that repeats until I force the Mac to shut down. The Console app's logs have several entries complaining of problems with com.taoeffect.ispy.kext. Is that responsible?

Bob Aspinall

That kernel extension may well be to blame. It's an old part of Espionage 2, probably migrated from a previous Mac. Ensure you have no more encrypted files, as removing this will prevent their decryption. In Finder, hold Option and choose 'Go > Library', then remove files with Espionage or iSpy in their name from the Application Support, LaunchAgents, LaunchDaemons, Services and PrivilegedHelperTools folders within this folder. Also do this in the Library folder at the top level of your startup disk. Finally, get rid of iSpy.kext from /System/Library/Extensions. Some of these will require your password. Restart



"My 21.5-inch iMac 21.5 (Late 2012) running OS X 10.11.4 has started freezing when I try to wake it from sleep. On entering the start of my password, that repeats until I force the Mac to shut down."

your Mac. If it continues to crash on waking, run Apple's hardware diagnostics by starting up with D held (a wired keyboard may help). You may find a memory or other fault that needs to be fixed by an authorised Apple repair centre, such as a Genius Bar. If your hardware is OK, try

installing the latest OS X Combo updater over your system. Remember to update security files afterwards (see bit.ly/1RsZJwA). You can also try starting up in safe mode, with Shift held from the startup sound till the Apple logo, to see if that helps.

Howard Oakley



Applying an OS X Combo Update (from support.apple.com) over your system can fix lingering problems.

Power up the Windows context menu

Cat Ellis shows how to make the right-click menu work for you by adding brilliant new tools and options, and removing the ones you never use.

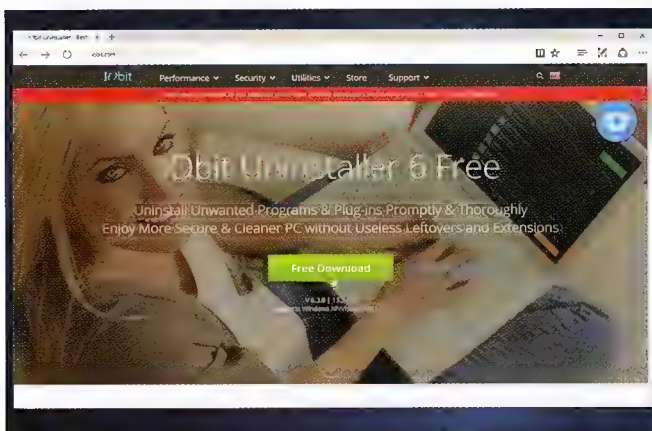
The Windows context menu, which appears when you right-click a file or folder, is packed with handy tools. Not only can you open, copy or delete a file or folder using it, you can also use it to pin items to the Taskbar for quick access, scan them for viruses with Windows Defender (very useful if it's something you've just downloaded), or create a handy shortcut.

The context menu is capable of so much more, though. With a few extra programs, you can transform this humble list into a powerful resource that will save you time and make everyday tasks effortless.

You can customise the Windows tools available when you right-click a file, making it easier to power down your PC, change properties or empty the Recycle Bin. Alternatively, if your context menu is cluttered, there's an easy way to get it under control so it only shows the options you use.

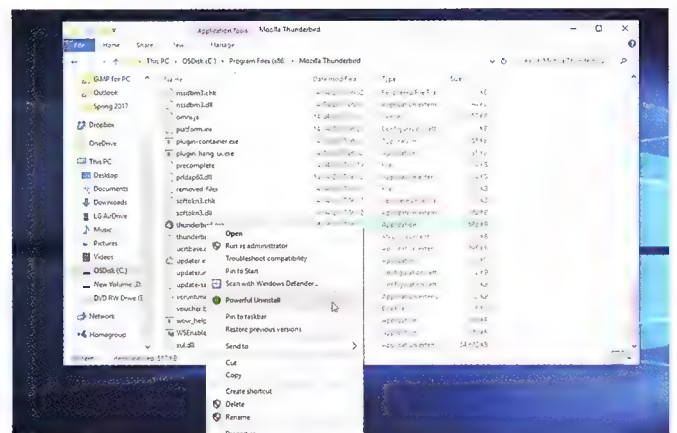


Create a bespoke right-click menu



1 MAKE UNINSTALLING EASIER

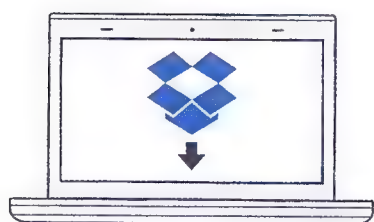
Usually when you want to remove a program, you have to do it through the 'Apps & Features' control panel, only sometimes items get left behind. There's a free tool called IObit Uninstaller that lets you remove any program by right-clicking its icon. Once it's finished, it performs a deep scan to make sure there's no junk left. Get it from www.iobit.com/en/advanceduninstaller.php



2 REMOVE PROGRAMS WITH A CLICK

Run the installer and the tool will be added to the context menu. To try it, right-click the icon of an app you don't want and select 'Powerful uninstall'. Check that the app shown is correct, then click Uninstall. You can create a Restore Point before you start, just in case. The app's own uninstaller will then run, and any residual files or registry entries will be identified for removal.

Your Dropbox download should start automatically in a few seconds. If it doesn't, restart the download.

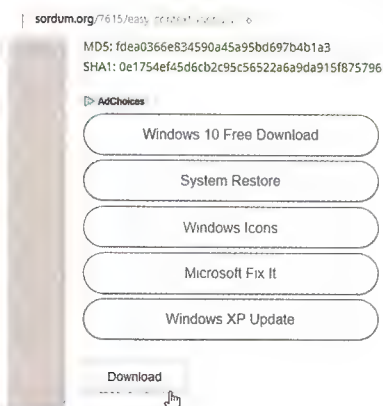


When your download is complete, run the Dropbox installer



3 GET INSTANT CLOUD STORAGE WITH DROPBOX

Another great tool for your context menu is Dropbox, which lets you send any file from your PC to an online cloud server, so you can access it from any device with an internet connection. The free version of Dropbox gives you 2GB space for your files, which goes a long way. To get started, go to www.dropbox.com and click 'Download the app', then run the installer.



5 BOOST YOUR MENU WITH EXTRA TOOLS

Easy Context Menu is a free tool that lets you add all kinds of handy tools to your right-click menu. Download it from tinyurl.com/apc444-easy (it's not obvious, but click the rectangular grey Download button at the bottom of the page). Extract the ZIP, and double-click EcMenu.exe. Easy Context Menu doesn't have to be installed, so it will start immediately.



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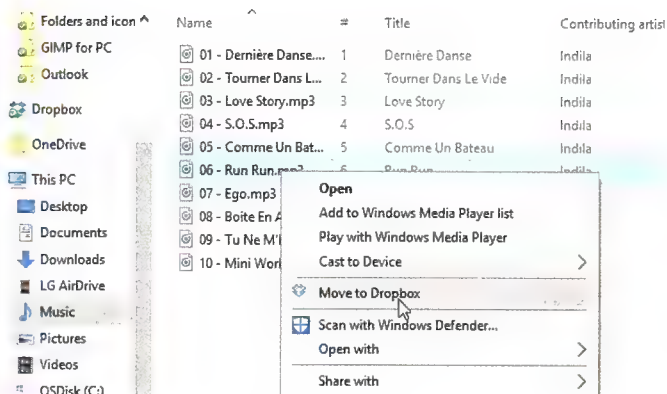


[Customize](#)

[No thanks, install free version](#)

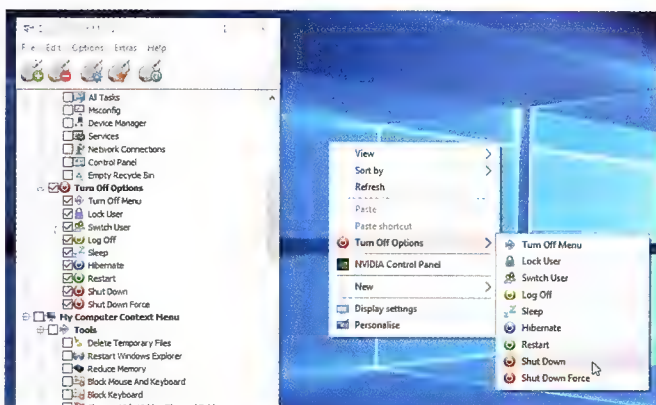
7 CLEAN UP THE CLUTTER

If your context menu is starting to look big and unwieldy, removing the tools and options you never use can make it much more manageable. To get rid of the junk, download the free version of CCleaner from www.piriform.com/ccleaner/download and run the installer. When you're offered a trial of the Pro edition, select 'No thanks, install free version'.



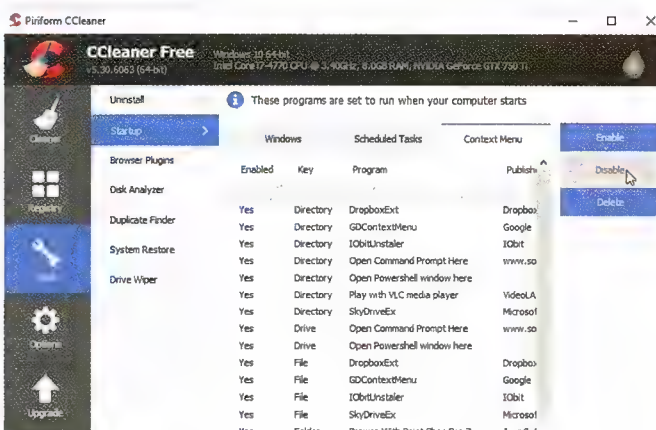
4 ACCESS YOUR FILES ANYWHERE

When the Dropbox app starts, you'll be asked to either create an account or sign in via Google. Once you've logged in, right-click a file and select 'Move to Dropbox'. The file will now be accessible from any device with the Dropbox app installed, or via the website. See the Dropbox icon in the notification area? If there's a green tick, the files you've moved have been uploaded.



6 ADD QUICK CONTROLS

You'll now see a huge list of options that you can add to the context menu. Some of these are advanced Windows tools that you won't need on a regular basis, but others — such as 'Turn Off Options' and 'Empty Recycle Bin' — are very handy to have at your fingertips. Check the boxes beside the tools you want to add, then click the green '+' icon on the top left to save the changes.



8 MAKE THE FINISHING TOUCHES

Run CCleaner and select Tools from the menu on the left, then click Startup and select the 'Context menu' tab. Take a look through the list; if there's anything you'd like to remove, just click it once and select Disable. You can always reactivate it later on if you change your mind. Congratulations! Thanks to these tools, you now have a fully customised context menu. ■

Create pro email signatures in iOS

Alan Stonebridge shows how you can to add website and FaceTime hyperlinks to your iOS email signature.

Many of us like to include hyperlinked text in our email signature. Often this will be a link to a website – perhaps for your business or maybe one for each of your social network accounts. Sadly, the ability to create signatures in iOS's Settings app is limited, and doesn't allow for hyperlinking text at all.

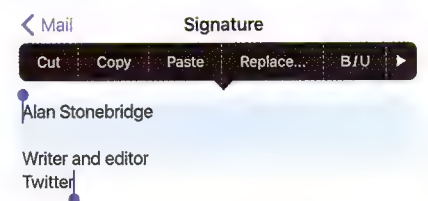
Thankfully, you can use Pages, which is now free for devices running iOS 10 or later, to work around this limitation. The walkthrough below shows how to accomplish this.

What you can't do solely with an iOS device, sadly, is create links for contacts who also use Apple devices to call you using FaceTime – Pages doesn't permit you to link to resources

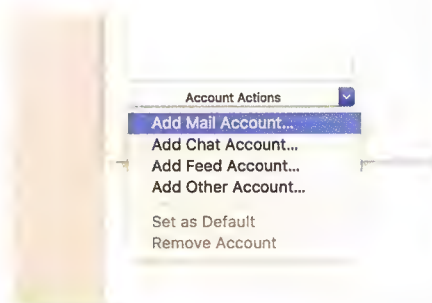
accessed using protocols other than HTTP. So we'll show you how to use Thunderbird (www.mozilla.org/en-GB/thunderbird), a free app for Mac with proper HTML-based message editing capabilities, to achieve this.

How to

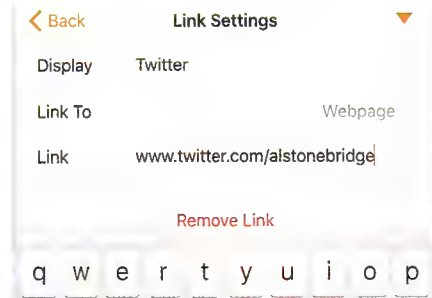
Style and hyperlink email signatures for iOS



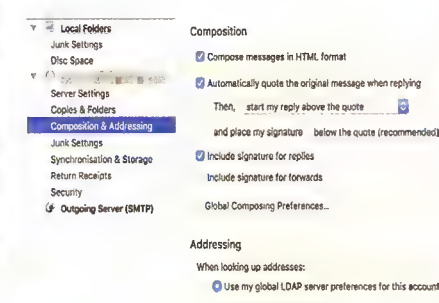
1 WRITE YOUR SIGNATURE
In 'Settings > Mail > Signature', type your signature and then select words you want to apply a bold, italic or underline style to. Copy the text to the Clipboard, then paste into a blank Pages document.



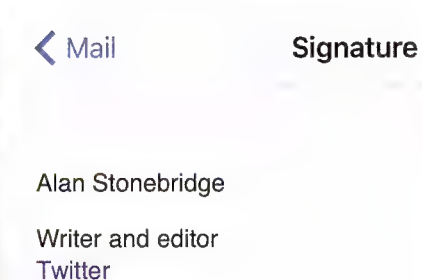
4 SET UP THUNDERBIRD
Configure your email account in Thunderbird on your Mac: choose 'Tools > Account Settings > Account Actions > Add Mail Account'. Server settings for some popular services are added for you.



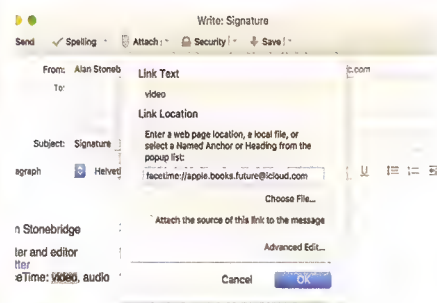
2 ADD HYPERLINKS
Select a part of your signature you want to hyperlink, then pick Link in the contextual options. Ensure 'Link To' is set to Webpage, enter an address next to Link, tap Done, and repeat as needed.



5 CHECK COMPOSITION
Select 'Composition & Addressing' and ensure 'Compose messages in HTML format' is enabled. Email your signature from iOS to the account just set up, then Control-click it and pick 'Edit As New Message'.



3 SET YOUR SIGNATURE
It's wise to avoid changing your text's font, so it matches the rest of your emails' contents. Text colour changes are fine, though. Copy and paste your styled signature back into the box in Settings.



6 ADD FACETIME LINKS
Select text to link, choose 'Insert > Link' and type "faceTime-audio://\" or "faceTime://\", then your FaceTime email or number. Email this to your iOS device, and copy and paste it as your signature.



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Master Mac parental controls

Use your Mac's built-in tools to make sure your kids have a safe experience when you can't be there.

There's no substitute for sitting with your child when they're using a computer to make sure they don't see or do anything that might be harmful. However, what parent hasn't been forced to divide their time between their kids and household chores? As your kids grow older, they may also deserve a certain amount of privacy when using the family Mac, too.

Fortunately, macOS offers the next best thing to watching over your kids' shoulders: the use of parental controls. These can be configured by creating managed user accounts for your children, and you can then enable or disable specific features. For instance, you may choose to disable the webcam and iTunes Store altogether, or set time limits on when the Mac can be used. Parental controls also includes 'whitelists' and 'blacklists' for websites

and apps to make sure your children are accessing only age-appropriate content. The settings are smart and you can make exceptions on a case-by-case basis.

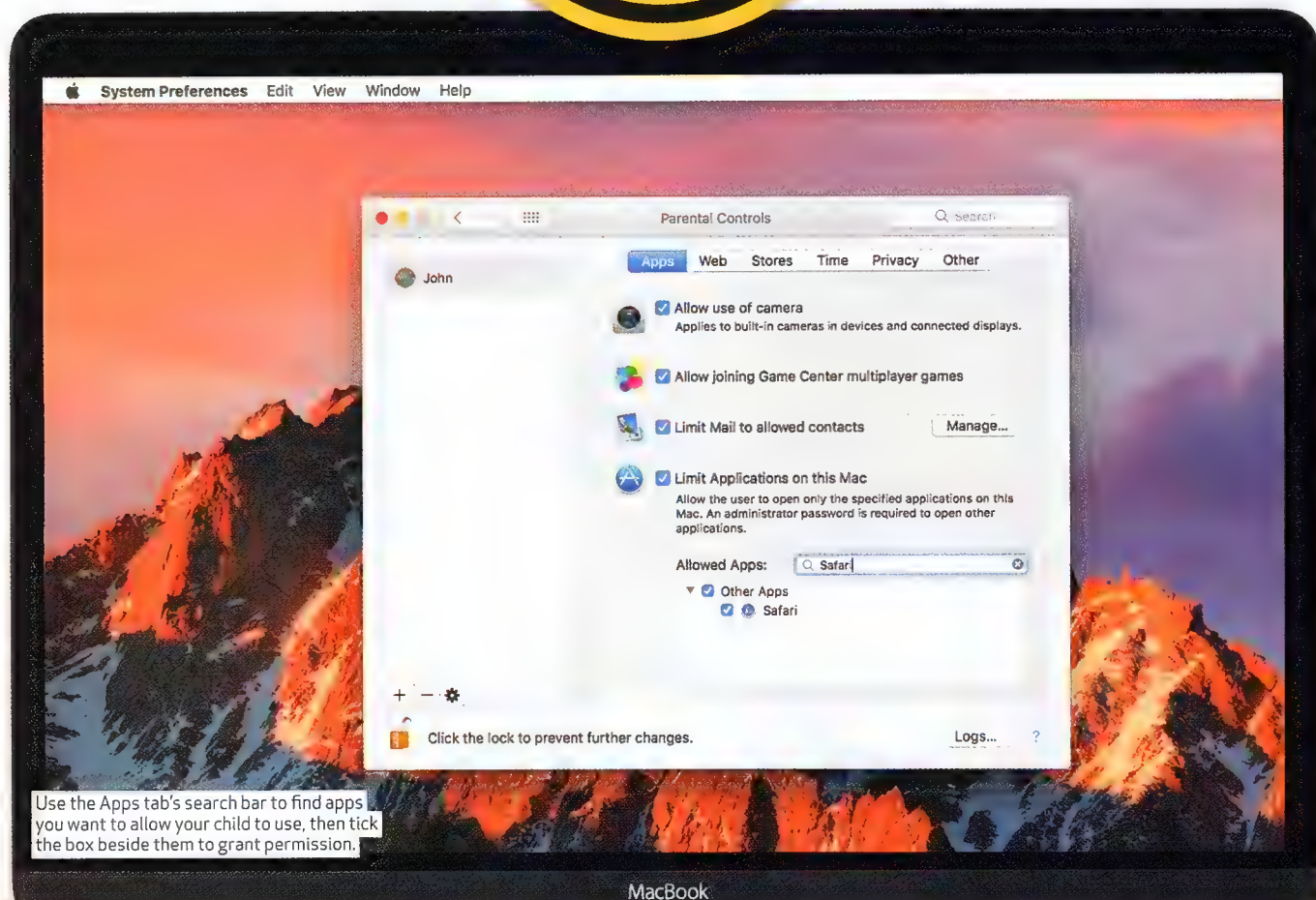
In this guide, you'll learn how to set up managed accounts for your children, as well as how to tailor

the parental control options as you see fit. You'll also discover some common ways tech-savvy kids try to circumvent parental controls, and how you can reduce the chance of this happening.

Master parental controls on Mac

LEARN THE BASICS OF ACCESSING AND CONFIGURING PARENTAL CONTROLS FROM SYSTEM PREFERENCES.

The account you initially set up in your own name on your Mac is an administrator account. Admins can make system-wide changes, such as installing new software. You can use this account to manage the parental controls that are applied to other accounts. You can also set up managed user accounts, from which users can



Use the Apps tab's search bar to find apps you want to allow your child to use, then tick the box beside them to grant permission.

"You can limit the overall time a child can spend logged in. You can also prevent them from logging in at certain times."

only access apps and content that you specify.

If your kids already have an account on the Mac, follow the steps in the guide below to convert their user account to a managed one. If you're setting up your Mac for the first time, or you and your children currently share a user account, follow the steps at apple.co/2q71m1i to create a managed account from scratch.

MISCHIEF MANAGED

Once a managed account has been set up, click 'Open Parental Controls' (bottom right of 'Users & Groups'). Later on, you can go to 'System Preferences > Parental Controls'. Access to the parental controls pane requires an administrator account's details to be entered.

In this pane, you can work through the options in the various tabs to decide what level of access is right for your child. By default, the Apps tab is selected. The first option here disables all webcams – the Mac's built-in FaceTime camera and any external ones you connect. Like all other settings, if your child needs to enable this for a special purpose, you can do so from their account by entering your admin password on a one-time basis.

The second option determines whether or not your child can join multiplayer games that use Apple's Game Center platform. Bear in mind

that not all games you install will make use of this – they may use other technologies to facilitate multiplayer gaming – but you can further restrict individual apps if you want.

Put a tick next to the third option, then click 'Manage' to set up a pre-approved whitelist of contacts with whom your child is allowed to exchange emails. This restriction applies only to the Mail app itself, not to webmail services, but you can filter websites, too.

Enable 'Limit Applications on this Mac' to ensure your child can only open apps on a pre-approved list. This is on an opt-in basis, meaning you must specifically approve each app by ticking the box next to it. Use the search box to quickly find apps you want your child to be able to use.

Click the Web tab to configure browser restrictions. By default, standard and administrator user accounts on a Mac are allowed unrestricted access to websites. Select 'Try to limit access to adult websites' and click 'Customise' to specifically list which websites are allowed and which should be blocked. If you have very young children, you may prefer the third option which limits web access to a select list of child-friendly sites. You can explicitly add more sites using the '+' button. These restrictions will apply no matter what browser your child is using.

Keeping logs

The parental control section keeps a log of your child's use of apps and websites they visit. To access the logs, click the padlock at the bottom left of the Parental Controls pane, then enter your admin account's credentials.

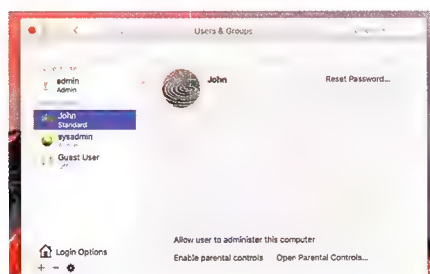
Select your child's managed account, then click 'Logs' to see their activity. First click on the 'Show Activity for...' pop-up menu to filter by time, such as today's activity.

There are two tabs: 'Applications' and 'Web'. Click the former to display a helpful pie chart which shows how your child has been dividing their times between apps. The box on the right lists them. Click the arrow to the left of an app for a more detailed look at the time and duration for which the app was used. Based on that info, you may want to tighten restrictions.

The Web tab displays a list of all websites accessed, and a similar pie chart detailing how long your child has spent on each one. Again, click the arrow beside each one to examine the number of visits and when they occurred. Select any unfamiliar site and click 'Open' to check their suitability.

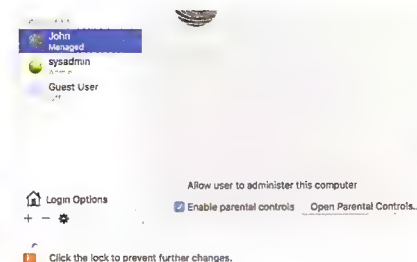
In the Stores tab, you can block your kids' access to the iTunes Store, iTunes U and the iBooks Store. If this seems like overkill, use the other options, which enable you to filter music with explicit content or enforce the age limit on movies, TV shows and apps. You can even block books

Set up a managed user account



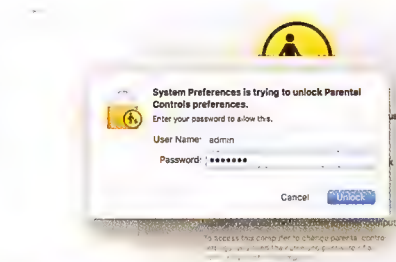
1 ALLOW USER

If your child already has an account on the Mac, go to **System Preferences > Users & Groups**. Select your child's account on the left-hand side, then make sure 'Allow User to Administer this Computer' is unticked.



2 PARENTAL CONTROLS

Click the 'Enable Parental Controls' option. Your child's account now appears as 'Managed' in the left-hand pane. Click 'Open Parental Controls', enter your admin account's credentials when prompted, then click 'Unlock'.



3 PICK PRIVILEGES

Work through the tabs and decide which privileges to grant. Pay careful attention to the Apps and Web entries. Once your child starts using the account, click 'Logs' (bottom right) to check which apps and websites they've accessed.

that are marked as having explicit content.

SET TIMES

If you're not so much worried about the content your child accesses as how long they spend in front of a computer, click the Time tab. You can limit the overall time a child can spend logged in. You can also prevent them from logging in at certain times, such as after 8pm on a school night.

Certain apps require access to data on your Mac such as Contacts and Calendar. Go to the Privacy tab to disallow access to anything, such as Twitter and Facebook, to which you think apps don't need access. There is no harm unchecking all of these, as you can always re-enable them later.

While in your checkbox frenzy, head to the Other tab and tick all the options there, too. This will turn off Siri, prevent your child burning DVDs without your permission, and display a simplified version of the Finder which is much harder to hack.

Hacking parental controls

LEARN ABOUT THE WORKAROUNDS FOR PARENTAL CONTROLS THAT YOUR LITTLE DARLINGS MAY TRY.

You may well encounter some resistance to setting up parental controls. Fortunately, macOS allows you to tailor the operations kids can perform, according to how responsible they are.

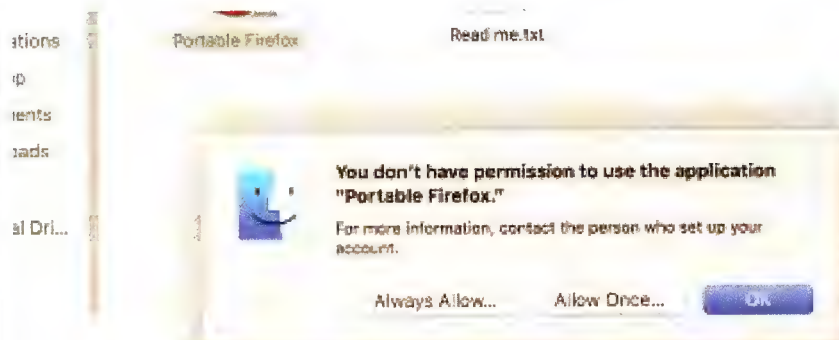
Some kids may decide, however, to take to the internet in an attempt to find out how to bypass these controls, and indeed there are a number of websites devoted to getting around the restrictions you've just set up.

The security of the restrictions depends on you keeping your user account password safe, so be sure to change it if your child used to share your account, or if you suspect they may know it. Make sure to do the same for any other admin accounts.

Your child's next best option if they want to undermine parental controls is to try to create a new, hidden admin account, so they can log in to the Mac and have unrestricted use.

TECH-SAVVY KIDS

There are several ways to create a new admin account, such as enabling the root account, or restarting in single-user mode and entering the necessary commands. Once this is done, a tech-savvy kid will most likely hide the account so it doesn't appear in the /Users folder, nor in 'System Preferences > Users & Groups'. Follow the steps opposite to make sure your child hasn't done this. Next, consider



Enable the parental controls for apps to make sure that software can't run from an external drive.

"If you haven't set up explicit app restrictions, gifted kids may try to install 'portable' apps to an external drive and run them from there."

setting a firmware password (see next page). This password prevents anyone starting up the Mac in single-user mode to enter commands that create a new account or otherwise interfere with your parental controls. If you do choose to set a firmware password, this will also be required each time you want to start up in macOS Recovery, in which the 'root' account can be enabled and passwords reset.

Another option your child may try is to install another operating system, such as Ubuntu Linux, on a flash drive and start up from this. As the system would load from that drive into memory, no trace of your child's activities would be left on the Mac. You can prevent starting up from external drives without first entering the firmware password by following the steps on the right. Write down the firmware password and keep it safe; if you forget it, you'll need to take your Mac to an Apple Store or Authorised Service Provider to reset it.

SMOKE AND MIRRORS

Should your kids find they're unable to create an admin account on the Mac or start up in another operating system, they may try to find workarounds within macOS itself.

In 'System Preferences > Users & Groups', make sure the Guest account is disabled, as parental controls will not log any activity there.

If you haven't set up explicit app restrictions, gifted kids may try to install 'portable' apps to an external drive and run them from there. You can prevent access to external drives by choosing the 'Simple Finder' option in the parental controls pane's

Detect hidden user accounts

Click Spotlight's icon and type "Terminal", select that app from the results, then press Return to open it. In Terminal's window, enter this command:

```
sudo defaults write /Library/Preferences/com.apple.loginwindow.Hide500Users -bool FALSE
```

This reveals hidden accounts on the login window. If all seems in order, log back in to your own account, open Terminal and enter:

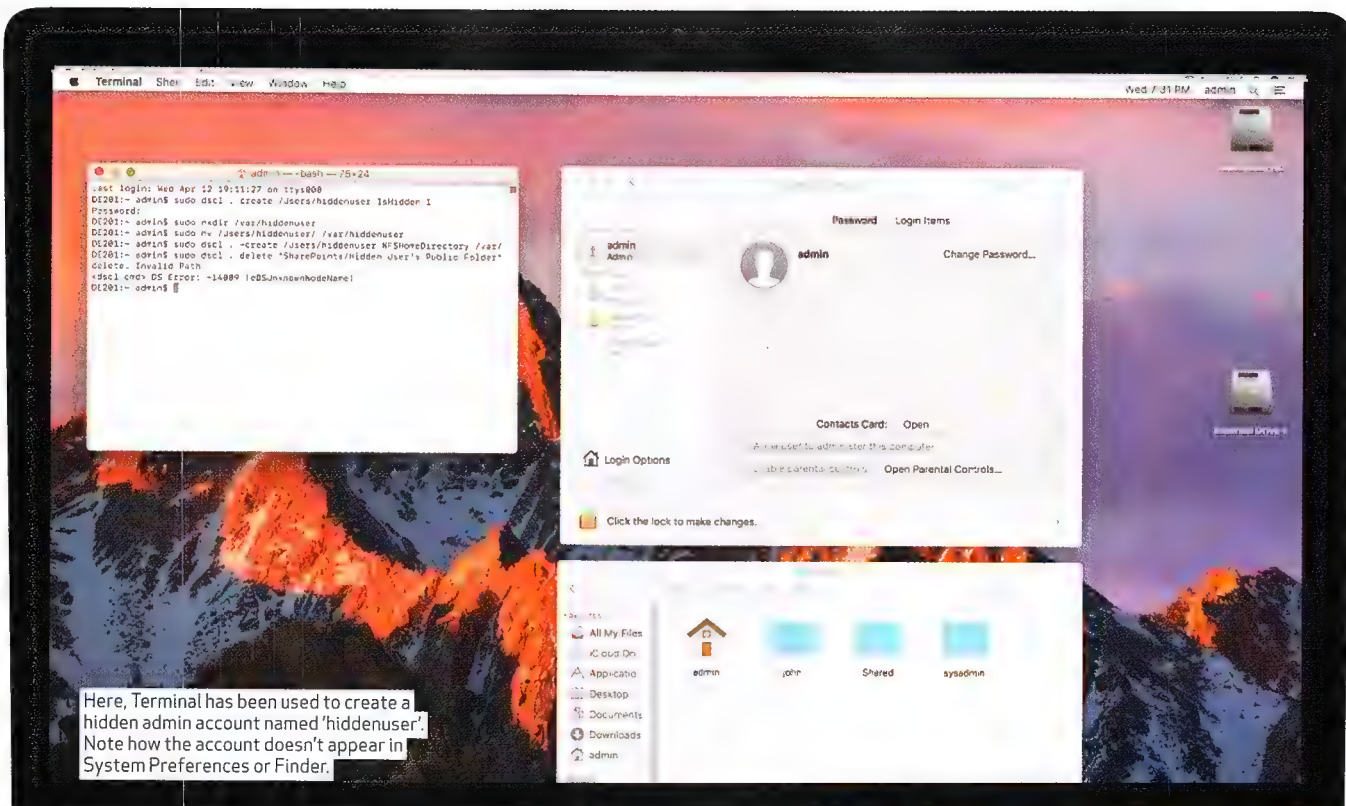
```
dscacheutil -q user | grep -A 3 -B 2 -e uid:\5'\[0-9]\[0-9]'
```

This will list every user account on the Mac. Check the 'name' value for any you don't recognise. The 'dir' value tells you the location of the home folder. If this doesn't start with '/Users', it's a hidden account. To remove a hidden account, type:

```
sudo dscl . -delete <dir>, for instance: sudo dscl . -delete /var/hiddenuser
```

If you prefer to unhide the account so you can investigate further enter:

```
sudo dscl . create <dir> IsHidden 0 For example: sudo dscl . create /var/hiddenuser IsHidden 0
```

Set a firmware password

Most modern Macs support firmware passwords, but if you're unsure yours does visit apple.co/2pOwb8l to check whether your model is compatible.

Restart your Mac holding Command-R to start up in macOS Recovery. Once that loads, click Continue on the language selection screen if it appears. From the menu bar, choose 'Utilities > Firmware Password Utility'.

In the new window that opens, click 'Turn On Firmware Password'. You'll be prompted to enter your password twice, the second to verify that you entered it correctly the first time. Make sure this is different to your user account's password and note it down in a safe place. Click 'Set Password' when you're ready.

Restart the Mac. You will be able to log in as normal. However, from now on, if you or anyone else wants to start up from a different drive, enter single-user mode or access macOS Recovery, the firmware password must be entered first.



If anyone tries to start up your Mac from another device, they'll see this screen prompting for the firmware password.



Other tab. Alternatively, choose to limit applications in the Apps tab to only those you approve.

When it comes to browsing the web, although you can block individual websites, your kids may be able to circumvent restrictions by visiting a web proxy – a website designed to bypass controls like these, which will fetch the website for them. Keep a close eye on their account logs; if you find they've been visiting such sites, add them to the banned list.

Certain websites, such as Pirate Bay, maintain mirrors – in other words, multiple copies of the same web page at different locations around the internet. For this reason, while one mirror such as thepiratebay.org may be on the blocked list, another such as pirateproxy.cc may still load. Again, watch your child's web activity closely and add mirrors of sites to the block list as necessary. ■

DIY Linux-powered router PC

Afnan Rehman delves into the world of networking to find out how to turn a Linux distribution into a fully functioning router.

It's time to take charge of your network. As individuals in the unfortunate situation of being both attracted to technology and prone having it fail on us, we've gone through our fair share of consumer routers. Hunting for this year's replacement we stumbled on a new idea, that you could build your own using Linux, with full control of the functionality and settings. What a novel idea! So we immediately retrieved a PC from the dungeon and set to work.

The idea of building a router is not completely new, but is growing in popularity among tech enthusiasts as a way to squeeze every last bit of performance out of your routing configuration while also maintaining full control in an era of cut-down app-controlled consumer products. The reasoning for building your own homebrew solution is that it makes the typical home or small office network completely your own. You control every aspect of the functionality from routing to IP tables to NAT and DHCP services. You can even add other functions to the router to control certain types of traffic, speeds and how devices are prioritised.

This tutorial will serve as a basic how-to on setting up a functioning router and giving you a platform on which you can expand further and take it as far as you'd like.

First, let's discuss the main components of any router intended to facilitate a home network. The router of today is often a bundle of many different components designed as a complete solution in one box. The ones

you see on shop shelves typically have the actual router hardware, a network switch (the network ports you see on the back) and a wireless access point, which enables a wireless signal to connect all your wireless devices. Often these consumer routers use only the hardware necessary, and have a low storage capacity, RAM and processing power. These small compromises can cause bottlenecks in your network, especially when you're using higher speeds from your internet service provider such as a 100Mbps connection or more. The ones that perform better often cost you an arm and a leg. The solution built in this tutorial only contains the core components of a router, not including a switch or wireless access point. However, you can add these separately.

SMALL IS BEAUTIFUL

Before we get down to the nitty-gritty of setup, let's take a moment to talk about hardware. Some of you may be wondering exactly what kind of hardware is necessary to create a functioning router. Some of you may also be wondering who in their right mind would use a full sized desktop tower to function as a router. For those of you not keen on the idea of displaying your old hardware in the middle of your study, fear not. The wonderful thing about modern technology is how it grows ever smaller and sleeker. This also applies



to the personal computer. For this project, we used a full-size desktop tower to test the idea, then moved everything over to a mini PC with dual Gigabit NIC about the same size as a consumer router for actual production use.

The hardware used for the build included a PC that was lying around rocking an Intel Celeron N3150 CPU with 4GB DDR3 RAM and a 64GB SSD. Is this overkill? Absolutely. Is this the cheapest system you can get to set this up? Probably not. You can certainly cut corners here using a smaller SSD, a spinning hard drive or even

```
router@router-ZBOX: ~
GNU nano 2.5.3      File: /etc/network/interfaces

# interfaces(5) file used by ifup(8) and ifdown(8)
auto lo
iface lo inet loopback

# The WAN interface, above the USB port
auto enp3s0
iface enp3s0 inet dhcp

# The LAN interface, above the HDMI port
auto enp2s0
iface enp2s0 inet static
    address 192.168.97.1
    netmask 255.255.255.0
```

In the interfaces file, you will see lines already present. Most likely they deal with the loopback interface and should be left alone. Add your changes below these.

Troubleshooting internet connection

Once you've rebooted after editing your network interfaces file the first time, you may notice that your internet connection has gone bad and you are no longer receiving an active connection. You may notice a message over the network interface saying "device not managed". This is because you altered the network configuration in the `/etc/network/interfaces` file for your two Ethernet ports. You can fix this by editing the network manager configuration file. You can open the `/etc/NetworkManager/NetworkManager.conf` file and change the line that says `managed=false` to `true`. Save the file and restart the network manager with the following:

```
# sudo service network-manager restart
```

Alternatively, we recommend setting up a wireless connection here or just make sure you had everything downloaded beforehand. If you need to reverse this, simply roll back the changes in the interfaces file and restart the computer.

If you are experiencing other issues, be sure to check the Ubuntu documentation at help.ubuntu.com/community/IptablesHowTo. The official Ubuntu documentation provides a lot of good information on not only how to fix problems, but how to edit configurations to add additional functionality such as logging.

an SD card to house the operating system, and you can certainly cut down on the amount of RAM. The processor can also be slower depending on what you want. We simply had these components on hand and frankly wanted top notch performance as well.

Most importantly, you must have at least two Ethernet ports, preferably Gigabit speed. The reason for this is simple: you need one port for a WAN connection (incoming from the internet) and one for LAN (outgoing traffic to local network). The LAN port can be connected to a switch to facilitate the use of multiple wired devices.

Now let's talk about the operating system. We're using Ubuntu Desktop to demonstrate this concept in a simple manner and most of the work will be done in the command line. Linux in general is built with routing in mind, making it a natural choice. As such, the instructions provided here can be adapted to almost any common Linux distro. In a lower-spec system, it may be wiser to use a minimal install such as base Ubuntu Server or CentOS Minimal to minimise the overhead taken up by the operating system, reserving your processing power for the actual routing.

SETTING UP

The first step is, of course, to install Ubuntu or your distro of choice. This is quite simple and there are plenty of guides online. Whatever you end up using, we recommend you make sure it has long-term support, such as the Ubuntu LTS version. This will ensure that there will be continued security updates for the foreseeable future,

which is important for a router that you may be using for a few years.

The first thing you want to do once you log in is find out which network interface is which. You might want to grab a pen and paper to keep track. The screen should show a couple of network connections, and one marked "lo" for the loopback which we won't worry about. Ours are labelled "enp2s0" and "enp3s0" and are both Gigabit Ethernet connections. Your hardware may vary, and the interface name may vary from what we have. Be sure to record these names, as you will be using them throughout this tutorial.

The next step is to configure your network interfaces now that you know which one is which. Type the following command into your console to open the editor:

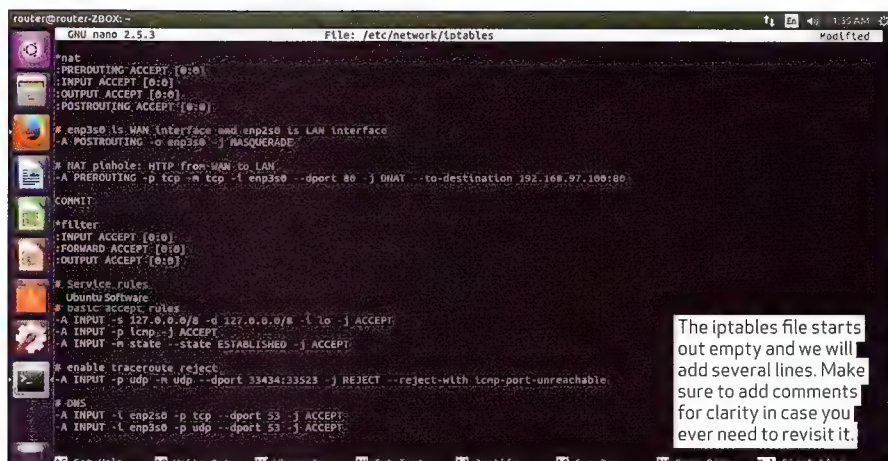
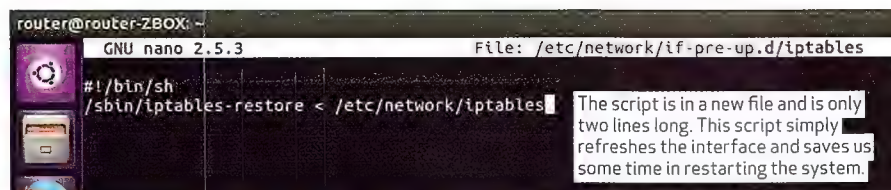
```
# sudo nano /etc/network/interfaces
```

You'll be greeted with a configuration file that already has

a couple of lines in it regarding the loopback interface. Leave those lines alone and type the following underneath them:

```
# The WAN interface, above the USB port
auto enp3s0
iface enp3s0 inet dhcp
# The LAN interface, above the HDMI port
auto enp2s0
iface enp2s0 inet static
address 192.168.97.1
netmask 255.255.255.0
```

As you can see, we have configured both our WAN (incoming) port and our LAN (outgoing) port. We also labelled them with comments so that we know which is which. This will become very helpful later when we are using these interfaces to write our rules for routing. The LAN port is configured with a static IP address that should correspond to the one of your current router. The netmask can also be determined by looking at the settings of your current router. Both may be different from what's listed above depending on your network, so make sure to double check. The WAN interface is configured with DHCP from your internet provider so we simply write the line above and leave it as is. Once you're done, save the file

A screenshot of a terminal window showing the contents of the `/etc/network/iptables` file. The file is being edited with GNU nano 2.5.3. The content includes rules for prerouting, input, output, and postrouting, as well as a filter section for the loopback interface 'lo'. A text box on the right side of the screenshot states: "The iptables file starts out empty and we will add several lines. Make sure to add comments for clarity in case you ever need to revisit it."A screenshot of a terminal window showing the contents of the `/etc/network/if-pre-up.d/iptables` file. The file is being edited with GNU nano 2.5.3. The content shows a script that calls `/sbin/iptables-restore` with the path to the `/etc/network/iptables` file. A text box on the right side of the screenshot states: "The script is in a new file and is only two lines long. This script simply refreshes the interface and saves us some time in restarting the system."


```

router@router-ZBOX: ~
GNU nano 2.5.3 File: /etc/sysctl.conf

# prevent some spoofing attacks
#net.ipv4.conf.default.rp_filter=1
#net.ipv4.conf.all.rp_filter=1

# Uncomment the next line to enable TCP/IP SYN cookies
# See http://lwn.net/Articles/277146/
# Note: This may impact IPv6 TCP sessions too
#net.ipv4.tcp_syncookies=1

# Uncomment the next line to enable packet forwarding for IPv4
net.ipv4.ip_forward=1

# Uncomment the next line to enable packet forwarding for IPv6
# Enabling this option disables Stateless Address Autoconfiguration
# based on Router Advertisements for this host
#net.ipv6.conf.all.forwarding=1

#####
# Additional settings - these settings can improve the network
# security of the host and prevent against some network attacks
# including spoofing attacks and man in the middle attacks through
# redirection. Some network environments, however, require that these
# settings are disabled so review and enable them as needed.
#
# Do not accept ICMP redirects (prevent MITM attacks)
#net.ipv4.conf.all.accept_redirects = 0
#net.ipv6.conf.all.accept_redirects = 0
# or
# Accept ICMP redirects only for gateways listed in our default
# gateway list (enabled by default)
#net.ipv4.conf.all.secure_redirects = 1
#

Get Help  Write Out  Where Is  Cut Text  Justify  Cur Pos
Exit      Read File  Replace  Uncut Text  To Spell  Go To Line

```

The sysctl file is where we will uncomment a line allowing port forwarding. This file has many settings, so be sure to only uncomment the proper line.

and reboot. Next, you will want to edit the file `/etc/sysctl.conf` and uncomment (by deleting the `#` symbol) the line that says `net.ipv4.ip_forward=1`.

This will allow packet forwarding for all network interfaces, which is essential to forward packets between your WAN and LAN networks. Save this change and run `sudo sysctl -p` to refresh the configuration.

TIME FOR TABLES

Now we get to the meat and potatoes of this tutorial. We are now going to set up iptables. Iptables is the most widely used Linux firewall for a long time, and we will use it here to sort and limit traffic incoming and outgoing, which will be essential if we are going to connect to the internet or any other device for that matter. The first thing we will take care of is setting up rules for packet forwarding that are applied before the network interfaces are started, which will ensure that, if we ever restart the router, packets will immediately be forwarded. First, we will install iptables-persistent, which

is a package that will allow iptables rules to remain after any reboots. Run the following command to install it:

```
# sudo apt-get install -y
iptables-persistent netfilter-
persistent
```

Once that's completed, let's set up a startup script to tell the operating system to run the iptables ruleset before the network interfaces become available, so that the router never goes online or accesses the internet without the protection of the iptables ruleset. Create the script using the command:

```
# sudo nano /etc/network/
if-pre-up.d/iptables
```

Populate the script file with the following two lines:

```
#!/bin/sh
/sbin/iptables-restore < /
etc/network/iptables
```

Now, save the file and run the following commands in the command line in the order given:

```
# sudo chown root /etc/
network/if-pre-up.d/iptables
# sudo chmod 755 /etc/
network/if-pre-up.d/iptables
```

The first tells the system that the script is owned by root and the second tells the system it is writeable by root and readable/executable by everybody.

Now we will create the iptables by creating a file in `/etc/network/iptables` with your preferred editor. Populate it with the following lines to start out:

```
*nat
:PREROUTING ACCEPT [0:0]
:INPUT ACCEPT [0:0]
:OUTPUT ACCEPT [0:0]
:POSTROUTING ACCEPT [0:0]
#enp3s0 is WAN interface and
enp2s0 is LAN interface
-A POSTROUTING -o enp3s0 -j
MASQUERADE
COMMIT
```

```
*filter
:INPUT ACCEPT [0:0]
:FORWARD ACCEPT [0:0]
:OUTPUT ACCEPT [0:0]
# Service rules
-A INPUT -j DROP
# Forwarding rules
-A FORWARD -j DROP
COMMIT
```

What we have done here is create a basic skeleton which includes 'nat' and 'filter' categories, each ending with the word 'commit'. One important thing this initial ruleset does is enable NAT, or Network Address Translation. NAT handles address translation between the local addresses on your local network, and addresses on the other side of the router. This makes sure the router knows where to send a packet of data coming in from outside, and send it to the proper client device on the local network.

We're not quite ready to go online yet. We want to also make sure the router can hand out IP addresses to clients just like a consumer router would. This part is very easy. First, we will install a DHCP server package:

```
# sudo apt-get install isc-
dhcp-server
```

Next, open the `/etc/dhcp/dhcpd.conf` configuration file and add the following clause to set parameters for router address, client IP range,

Where to go from here...

Now that you have a finished router, you may be itching to go even further. There are limitless possibilities for what to do now. The interesting thing about building your own router is that you are now in charge of both your hardware and software, and you will have resources to spare to add functionality such as ad-blocking software, and have it all in one box. If you wish to add extra functionality, there are many tutorials on the internet to help you on your journey. You can also work on adding new hardware, such as network expansion cards, additional storage and RAM, even adding additional operating systems and

programs to make a multifunctional server system. You can purchase wireless access points and network switches to connect all your wired and wireless devices to the router and ultimately to the internet. What you do here is completely up to you. We also recommend taking steps to ensure that your router functions well and for as long as you need it. Simple maintenance tasks such as dusting it every six months or so will reduce noise and heat generation, greatly increasing the lifespan of your hardware and allowing you to reap the benefits of a high performing and heavily customisable router for years to come.


```

GNU nano 2.5.3 File: /etc/dhcp/dhcpd.conf

# You can declare a class of clients and then do address allocation
# based on that. The example below shows a case where all clients
# in a certain class get addresses on the 10.17.224/24 subnet, and all
# other clients get addresses on the 10.0.29/24 subnet.

#class "foo" {
# match if substring (option vendor-class-identifier, 0, 4) = "SUNW";
#}

#shared-network 224-29 {
# subnet 10.17.224.0 netmask 255.255.255.0 {
# option routers rtr-224.example.org;
# }
# subnet 10.0.29.0 netmask 255.255.255.0 {
# option routers rtr-29.example.org;
# }
# pool {
# allow members of "foo";
# range 10.17.224.10 10.17.224.250;
# }
# pool {
# deny members of "foo";
# range 10.0.29.10 10.0.29.230;
# }
#}
subnet 192.168.97.0 netmask 255.255.255.0 {
range 192.168.97.50 192.168.97.199;
option routers 192.168.97.1;
option domain-name-servers 192.168.97.1;
option broadcast-address 192.168.97.255;
}

```

The DHCP configuration file has a decent amount of content already. Add your configuration lines at the very end, taking care not to edit anything else.

and broadcast address:

```

subnet 192.168.97.0 netmask
255.255.255.0 {
range 192.168.97.50
192.168.97.199;
option routers 192.168.97.1;
option domain-name-servers
192.168.97.1;
option broadcast-address
192.168.97.255;
}

```

Of course, be sure to change these specific addresses based on your network situation. You can set whichever parameters for client IP addresses you wish, and the range can be as large or small as you want. To apply the configurations, we just run the following command:

```
# sudo /etc/init.d/isc-dhcp-server restart
```

We are still missing a local DNS; however, this is even easier to acquire. Simply run the following command, no configuration will be necessary:

```
# sudo apt-get install bind9
```

LOOSENING UP

At this point, all the basics are there, and our router is now able to handle DNS queries, give IP addresses to clients and forward traffic. However, our rules are currently so extremely strict that it will refuse to do any of this. What we will do now is add several rules to the ruleset to specify what traffic goes out to the internet, what can go into the local network from the internet, and rules for port forwarding.

So we'll go back to editing `/etc/network/iptables` and start with creating a service ruleset, forwarding rules, and NAT prerouting. Our complete ruleset is shown below:

```

*nat
:PREROUTING ACCEPT [0:0]

```

```

:INPUT ACCEPT [0:0]
:OUTPUT ACCEPT [0:0]
:POSTROUTING ACCEPT [0:0]
# enp3s0 is WAN and enp2s0
is LAN
-A POSTROUTING -o enp3s0 -j
MASQUERADE
# NAT pinhole: HTTP from WAN
to LAN
-A PREROUTING -p tcp -m tcp
-i enp3s0 --dport 80 -j DNAT
--to-destination
192.168.97.50:80
COMMIT

```

```

*filter
:INPUT ACCEPT [0:0]
:FORWARD ACCEPT [0:0]
:OUTPUT ACCEPT [0:0]
# Service rules
# basic accept rules
-A INPUT -s 127.0.0.0/8 -d
127.0.0.0/8 -i lo -j ACCEPT
-A INPUT -p icmp -j ACCEPT
-A INPUT -m state --state
ESTABLISHED -j ACCEPT
# enable traceroute reject
-A INPUT -p udp -m udp
--dport 33434:33523 -j REJECT
--reject-with icmp-port-
unreachable
# DNS
-A INPUT -i enp2s0 -p tcp
--dport 53 -j ACCEPT
-A INPUT -i enp2s0 -p udp
--dport 53 -j ACCEPT
# SSH
-A INPUT -i enp2s0 -p tcp
--dport 22 -j ACCEPT
# DHCP client requests -
accept from LAN
-A INPUT -i enp2s0 -p udp
--dport 67:68 -j ACCEPT
# drop all other inbound
traffic
-A INPUT -j DROP

```

```

# Forwarding rules
# forward packets along
related connections
-A FORWARD -m conntrack
--ctstate RELATED,ESTABLISHED
-j ACCEPT
# forward from LAN to WAN
-A FORWARD -i enp2s0 -o
enp3s0 -j ACCEPT
# allow traffic from our NAT
pinhole
-A FORWARD -p tcp -d
192.168.97.100 --dport 80 -j
ACCEPT
# drop all other forwarded
traffic
-A FORWARD -j DROP
COMMIT

```

The service ruleset is under the filter area and will make rules for what the router can accept and what it can forward to the local network. Here, we also allow SSH access so that once the router is configured, we can remote-in to make changes rather than plug in a monitor and keyboard.

The part labelled 'forwarding rules' instructs the router to forward traffic to the LAN and from the LAN to the WAN for outgoing traffic. In addition, we add a line to the NAT section to create a NAT pinhole instructing the router to forward any arbitrary traffic from the internet to the local machine at the specified address. Ensure that the PREROUTING and the FORWARDING rules are there and in the right places.

To wrap up, restart your iptables by running the following:

```
# sudo /etc/network/if-pre-up.d/iptables
```

Once you've done that, you should be good to go! Enjoy your new and improved routing experience! ■

Turn home video pro with Lightworks

Alex Cox shows how to improve your vids with post-production software.

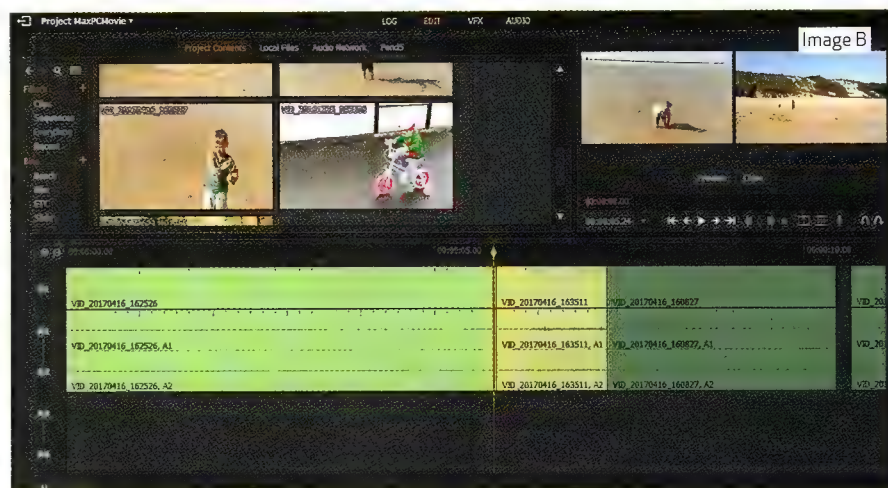
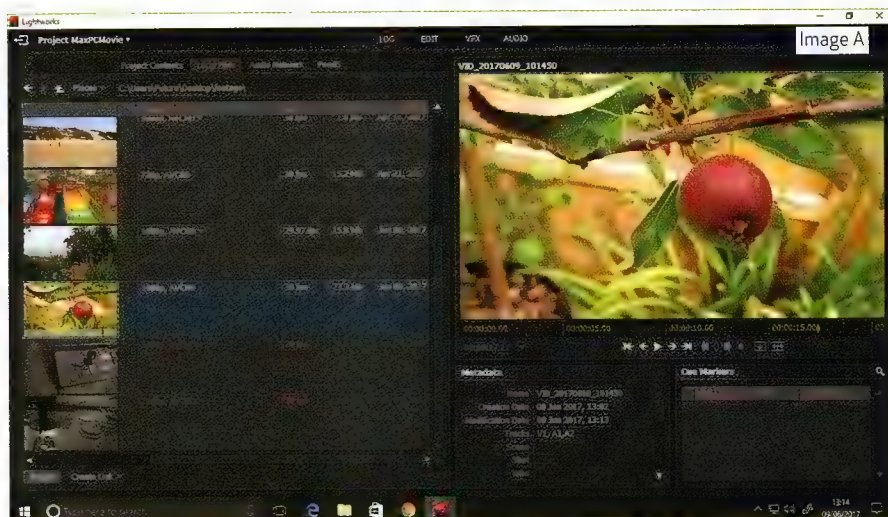
It's truly amazing what we all carry in our pockets. Never forget that your cell phone is a modern marvel, packing in a closet's worth of tech and tools, particularly when compared to the equivalent from 20 – or even just 10 – years ago. And it's great for on-the-fly productivity. Complete albums have been made from scratch on mobiles, people have written novels and scripts, and to get to the point, entire movies have been shot on iPhones, and received cinematic releases. So that's one piece of the puzzle – you have everything you need to collect footage.

To splice it, tweak it and give it that professional shine, why not lean on a tool that's legitimately been used to put together Hollywood blockbusters? Lightworks, matured for 25 years in the movie industry, was part of the toolchain that produced the likes of *Pulp Fiction* and *The Wolf of Wall Street*. Its basic version is available for nothing, and while this free edition lacks a few more advanced features, it's still plenty powerful, and there's lots tucked away in its interface that'll change the way you make home movies in the future.

1 INSTALL AND COLLECT

It's the first step – you know what that means: Download Lightworks from www.lwks.com and get it installed. It pulls in any dependencies, such as Visual C++, for you, so you can get away with just clicking 'Next' until you're done. There's a step that asks you to assign a machine number, but this is only really relevant if you're running multiple editing stations, so you can leave it at '1'.

Now is also a good time to collect your footage together into a single folder, presuming you've already taken it. If not, film at the highest resolution you can, and be aware that while we'll take some steps to improving the end product, there's nothing Lightworks can do to make bad footage good – check your focus carefully, try to keep your camera steady, and do arty things, such as blurring the background in-camera, rather than presuming you'll be able to rely on software.



2 FIRST STEPS

Oddly, Lightworks didn't install a 'Start' menu shortcut on our test machine, so you may have to hunt its executable down in the 'Program Files/Lightworks' folder to get it running.

Click 'Create a new project' on the initial splash screen, give it a name, then select the frame rate. This needs to match the frame rate of your footage, unless you want it sped up or slowed down; if you have footage with mixed frame rates or odd codecs, try a tool such as EyeFrame (eyeframeconverter.wordpress.com) to normalise it before importing.

Alternatively, you can opt for a mixed rate project, but standardising everything is a far better option.

Finally, click 'Create' when you're happy.

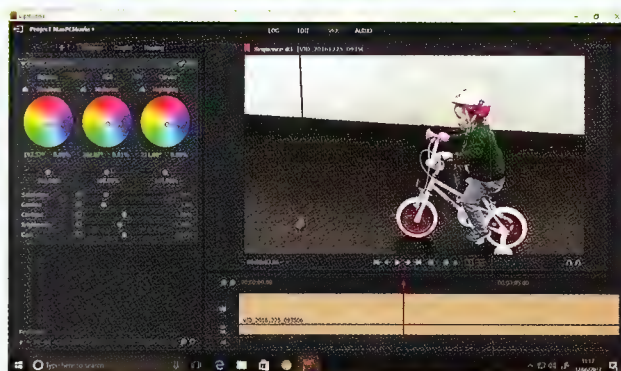
3 INSERT VIDEO FILES

Lightworks opens to its project management window, labeled 'Log'. Assuming you've collected your footage together in a single folder, head to the 'Local files' link at the top of the window, and navigate to that location. Video that's not compatible with your project is greyed out – check the red markers in the info columns to discover why it won't work. In this case, we've slipped some 20fps footage into our folder for a 30fps project [Image A]. Double-click any file to both open a preview in the right-hand pane, and add it to your working library of clips,

Colour grading

Although image sensors in mobiles are pretty damn good these days, many of them can't quite get the colour right. Lightworks offers up a host of tools to correct this, most of which are best applied to clips individually. Head to the 'VFX' window, and begin by adjusting the overall RGB curve of your clip to give it slightly more contrast, then look for any colours that are blown out or oversaturated — you can pull these down a little either by using individual curves or in the RGB panel.

When you're happy with each clip, an overall colour caste will give your whole sequence that Hollywood "everything is murky" final touch. Use the wheels in the 'Main' window to tweak the shadows, midtones and highlights to match the particular feel you are going for, then drop the saturation right down, and lower the brightness slightly, to get that neutral, gloomy feel that movie editors seem to love so much.



Unfold the effect from the clip you're working on, and then drag it to cover your whole sequence to add consistency.

which can be found under 'Project Contents'. This can be further sorted into bins, if you're working with a lot of clips. Click the plus icon next to 'Bins' on the left, enter a name, then drag videos from the 'Clips' folder into the appropriate bin. This is all non-destructive; it just keeps you organised. If you're seeking inspiration or something particular for your movie, you can use the top links to dig through the Pond5 and Audio Network libraries of pre-cleared music, sounds and stock footage, though this usually incurs a fee.

4 CUT AND SPLICE

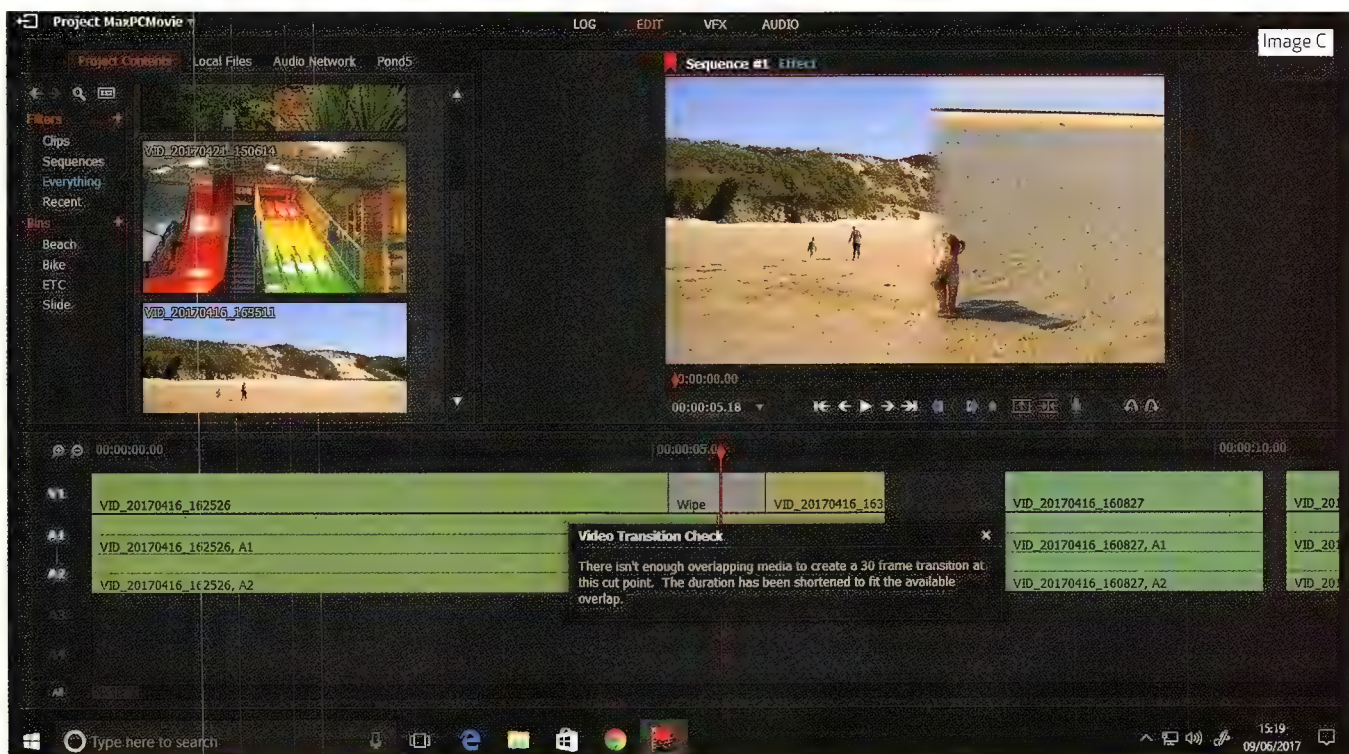
Click 'Edit' at the top to enter the editing suite. The footage you pulled in

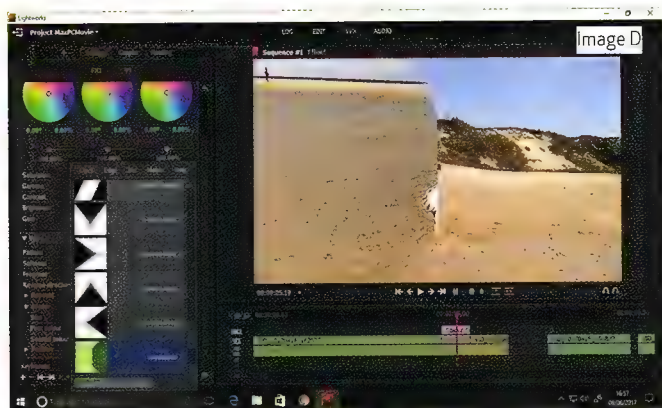
is in the top-left pane. Drag a clip into the bottom pane, and you add it to the current sequence. Drag another clip into the timeline overlapping it [Image B], and you've created a basic cut between them; grab the red transport control line, place it at the start of your timeline, and hit 'Play' (or drag the transport control) to see a preview of what you've just done. We're working non-destructively, so your original clips won't be affected by anything we do from here on, and you can treat sequences in exactly the same way that you'd treat individual clips when you're compiling your final video.

5 TOP AND TAIL

Let's delve a little deeper into

Lightworks' editing interface, which is probably the most easy-to-comprehend video editor we've ever worked with. Hover your mouse over the end of a clip in its timeline, and you'll see the edges of the video and audio portion light up white; drag this to trim the clip or lengthen a pre-trimmed clip. Hover over a transition so that the end of one clip and beginning of another are highlighted, and click. With both elements now highlighted yellow, you can drag this transition to affect precisely when the cut takes place, leaving each individual clip in exactly the same place; if you'd rather move the clip, deselect everything and simply drag it. Double-click the beginning of a clip and drag, and you move that and





subsequent clips, keeping the original transition point and any transitions you've made after it. If you want to edit video independently from audio, deselect the track you're not interested in by clicking its title on the left of the timeline. A few minutes of play, and it's a second-nature interface.

6 GOING BETWEEN

Straight cuts are the most frequent tool you'll use to splice your clips together, but they're by no means your only option. Overlap a couple of clips, right-click the intersection between them on the video track (the uppermost of the three, labeled 'V1') and click the 'Add' button below 'Transitions' to see a selection of five basic effects, which can be applied between clips. Select one – we favour the *Star Wars*-esque 'Wipe' move – and it's added as a new element. The default length is 30 frames; if there's not enough overlap, Lightworks shortens the transition [Image C] and lets you know. Transitions can be tweaked just as you'd alter a clip, so you can reposition them, or drag their edges to lengthen or shorten them. You can't add a transition to the beginning or end of a transition

(that would be mad), but if you want to try a different effect, you can right-click and replace it with something else, delete the transition and start over, or select 'Settings' to go a bit more in-depth.

7 TRANSITION SETTINGS

Tweaking the settings of our transition takes us on our first foray into Lightworks' VFX editor. Ignore the colour grading options for now, and look at the lower portion of the left window [Image D] to find the controls specific to your transition. If you've chosen the wipe, for instance, you'll find pattern options – bear in mind that the default has been selected, because it's by far the most tasteful, so don't go too mad here – as well as sliders, which affect the specific variables of the transition. If you'd like these to change over time, look for the pie chart icon to the left of individual sliders, which makes that particular setting respect keyframes. You get two by default, at the start and end of your transition, and you can add a new keyframe at the current transport point by clicking the 'Plus' button, and reposition it by dragging. Click one keyframe, adjust a linked slider and



repeat for each one – if you now drag the transport control, you'll see the slider change, proportionally, over time.

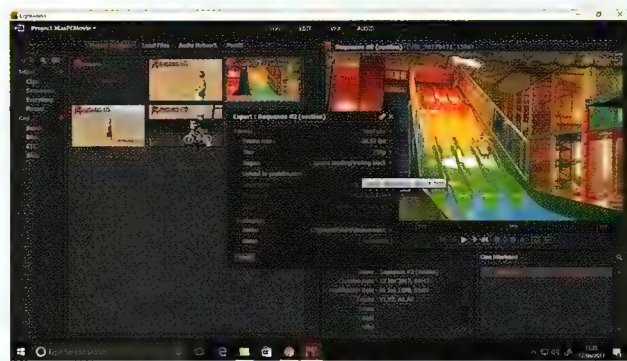
8 MORE TRACKS

Before we turn our mobile footage into gorgeously graded movie gold, which is surely what you've come for, let's bury the lede even further, and show you a final few timeline tips. Head back to the 'Edit' window, and right-click the preview window above, to bring up a list of actions you can perform on the current sequence. This is where you can add new video tracks and audio tracks – though it's often much easier to edit individual sequences with a single set of tracks, so think carefully as to whether you need this. Check out the 'Remove' submenu [Image E], which is handy if you're just sketching out a sequence: You can use it to automatically trim out any gaps in your timeline or remove unnecessary cuts. Speaking of which, splitting a track on the timeline requires a bit of roundabout trickery. Below your preview, you'll see two blue buttons, which enable you to mark the start or end parts of a section of footage for

Exporting footage

Lightworks' basic edition supports all kinds of footage when it comes to editing, but getting it out the other side is another matter. You're stuck with 720p Vimeo- or YouTube-suitable output. Frankly, though, if anyone is expecting you to share your home movies in 4K at 120fps, they're probably not going to be on your list of preferred friends for long.

To output your footage, head to the 'Log' window, right-click the sequence you want to save, hover over 'Export', and select Vimeo or YouTube. There's not much here in the way of complex options, but doubling up your frame rate may lead to smoother footage when exported. You can, if you wish, enter relevant account details, and automatically upload your footage, but hitting 'Start' at the bottom of the export window and saving it is a more flexible option. Lightworks renders your clip in the background (meaning you can keep working on other things), and pops up an alert when it's done.





trimming purposes. Clear all your markers (if necessary) by clicking the button between them, then move the transport control to the exact point you'd like to split. Insert an in mark, then click one of the red delete buttons to split the track – essentially deleting a zero-pixel-wide section, leaving the clip in two parts.

9 BEAUTIFY IT

Once you've finished your editing job – and we're very aware that this is a "draw the rest of the owl" kind of statement – it's time to add some flair. Lightworks has a massive bag of visual effects to choose from, and they're hidden, like its transitions, behind some fairly unassuming menus. You need to apply effects to a single clip to begin with, so in the edit suite, move the transport control to the clip you want to work with, then hit 'VFX' at the top to jump to the effects suite. Hit the plus button (top-left) to see your favourites list, which is sparsely

populated by default, and use the drop-down list at the top-right to pick from categories. Some of these, such as Key, Mix and Matte effects, are only really applicable if you're layering up multiple video tracks – some, such as those in the 'DVE' menu, are reminiscent of cheesy effects from the mid-'80s and should be avoided at all costs. Head to the 'Stylize' window instead, and select a Top and Bottom vignette, then add another effect on top: a Sharpen – perfect for getting that cell footage looking crisp [Image F].

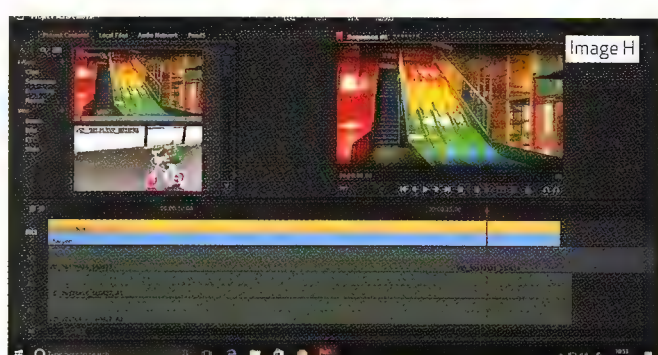
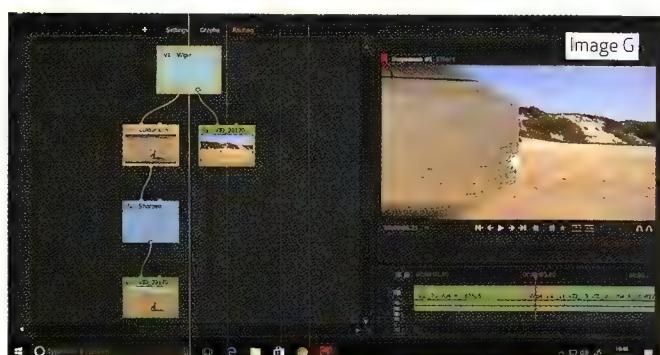
10 SMOTHER IT

Once you've tweaked the settings of each filter to your liking – the relevant sliders appear in the left column of the VFX interface, and can be keyframe linked in the same way as linking transitions, or rearranged in the routing panel [Image G] – you may wish to apply them to your whole movie. Much like every other element

in Lightworks, effects are treated as objects of their own, although when first applied, they're tucked away – or, in Lightworks terms, 'folded in'.

Right-click the clip you're editing, and click 'Unfold'. The effects you just added appear in a new timeline track, 'FX', and can be manipulated in the same way as any of your timeline elements.

Stretch out the track to cover your whole sequence [Image H] for a uniform effect, and combine this with colour grading – see boxout back over the page – for a truly pro finish. There are no limits here. You can safely apply effects to individual clips, then place others over the top. Be frugal, though, as it's easy to over-process your footage, and take it from looking classy and clean to terrible and unwatchable. If you've crossed the line, right-click the effect on the FX track of your timeline, and use the remove options to take out the culprit. ■





A renewed office workhorse

We decided to reuse some old hardware to breathe life into a new office desktop, says Zak Storey.

THE CONCEPT

Rest in pieces, my merry little workstation, you served this editor well. Over the last 18 months, your tiny ITX form factor made you an office dream, and contributed to vast quantities of words in the battle against magazine deadlines.

Featuring a Core i7-4790K, 16GB of DDR3, and a GTX 970, this SSD-powered, liquid-cooled machine lay within Fractal Design's Define Nano S, looking lively each morning, and serving the magazine with vigor until its dying day. Alas, thanks to one too

many ghosts in the system, one too many BIOS glitches, we had to put "Old Yeller" down for good.

When it comes to review hardware, we usually consider the parts to be loans. If a manufacturer requests a part back, we return it as soon as possible. Some manufacturers leave us permanent samples (CPUs and reference GPUs, in particular), so we can work closely with their AIB partners and compare against future launches; other parts we request to hold on to (motherboards for dedicated test benches); and some companies

just forget to collect their gear (power supplies, SSDs, memory and so on). Cases are usually a permanent fixture, because shipping them back and forth to tech journalists across the US is a nightmare.

So for this build, the rules are as follows: Key components (processors, motherboards, power supplies and the like) can't be less than a year old, cases have to be reviewed, and the GPU can be as new as you like, as it's easy to swap out.

IT'S ALL ABOUT BALANCE

The Phanteks Eclipse P400S, at just \$119, has a gloss white finish, solid metal panels, tempered glass, magnetic dust filters, hidden SSD mounts, a PSU cover, a fan controller, RGB lighting, noise dampening and a magnetic 12-inch RGB LED strip. Exceptional spec for the price, and it looks outstanding.

From the cupboard, we dragged out our ageing Core i7-5820K, for 6 cores and 12 threads of pure perfection, plus 32GB of quad-channel Crucial Ballistix Elite DDR4 and baked all of it into the ASUS X99 TUF Sabertooth and baked all of it into the ASUS X99 TUF Sabertooth we've had kicking about since 2015.

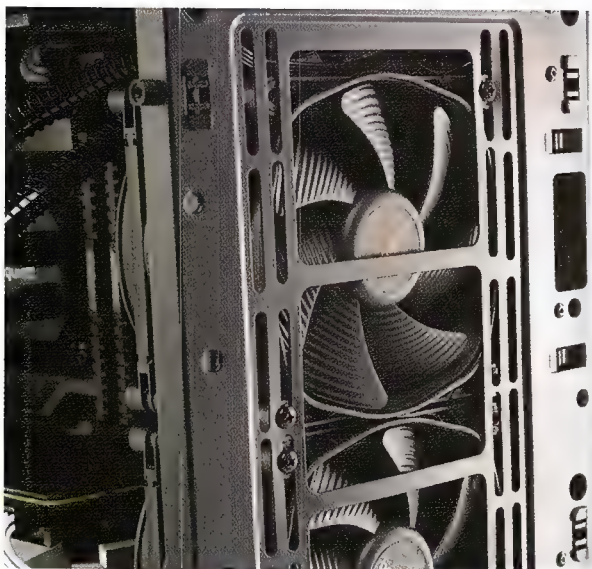
We reused the Crucial MX200 960GB SSD as the data drive here, but as its now end of life, we'd recommend the 1.1TB MX300 instead. For the OS, we used Kingston HyperX's Predator M.2 PCIe SSD.

In 2016, Be Quiet! sent us a sample of its upcoming 240mm AIO Silent Loop. Unfortunately, it never made it past Asetek's trademarking campaign against the closed-loop liquid-cooled industry in the US, and it's yet to make it on sale. You can buy it, but it's extortionately priced, and imported from Europe.

For GPU, we went for a reference GTX 1080 Ti. We're starting to receive a lot more aftermarket 1080 Tis, so popping this isn't the end of the world. And if we need it for something else, swapping it out for another isn't going to be an issue. It can easily handle the two 27-inch 144Hz screens connected to the build, with more than enough grunt for lunchbreak gaming in ultra spec glory.

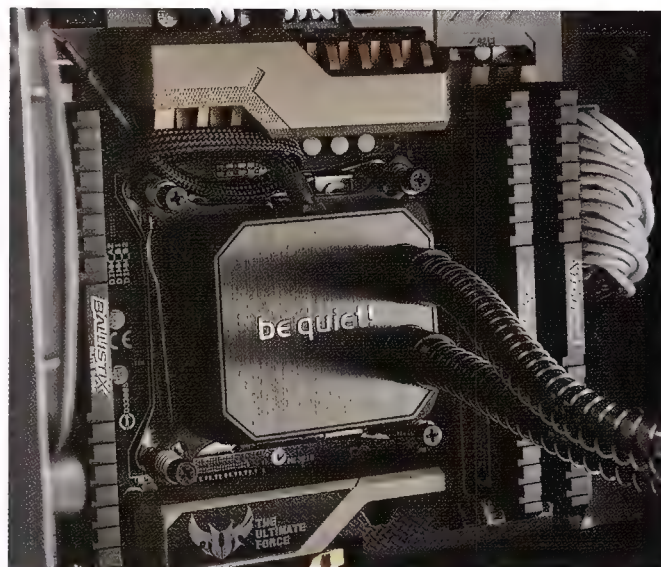
PARTS LIST

PART		STREET PRICE
CASE	PHANTEKS ECLIPSE P400S	\$119
MOTHERBOARD	ASUS X99 TUF SABERTOOTH	\$549
CPU	INTEL CORE I7-5820K	\$550
MEMORY	32GB (4X 8GB) CRUCIAL BALLISTIX ELITE DDR4 @ 2,666	\$329
GPU	EVGA GEFORCE GTX 1080 TI	\$879
PSU	CORSAIR AX1200I	\$419
STORAGE 1	240GB KINGSTON HYPERX PREDATOR M.2 PCIe SSD	\$230
STORAGE 2	1.1TB CRUCIAL MX300 2.5-INCH SSD	\$439
COOLING	BE QUIET! SILENT LOOP 240 + 5x BE QUIET! SILENT WINGS 3 HIGH SPEED 120MM	\$314
OS	WINDOWS 10 HOME	\$179
TOTAL		\$4,007



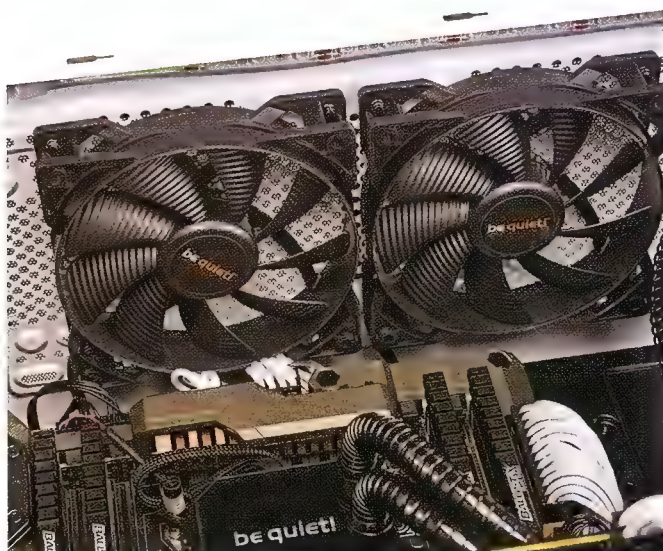
1 DUST FILTERS?

We know what you're thinking. "Where are them filters at?" We haven't removed them for the sake of snapping a clearer picture here — they're actually baked into the front panel in a very intuitive way. Because of the design of that panel, the only air intakes are situated at the top and the bottom of the trapezoid-shaped structure. What Phanteks has done is create two tiny, removable fan filters, which slot across both of these entrances. This saves on cost for Phanteks, and still acts as an effective dust filter for the end user.



2 UNRELEASED AIO

It's a shame that the Be Quiet! 240mm AIO Silent Loop never made it to market, because it's truly a thing of beauty. The brushed aluminium block is exceptional, with a single braided cable for the pump and that's it. No LEDs, no excess mess, and a fantastically simple mounting solution. Even the coil-wrapped tubing grows on you over time. It's right at home with our 32GB of Crucial Ballistix Elite and the X99 TUF Sabertooth motherboard. Our white AX1200i cables, on the other hand? Well, they're starting to look a little grubby, so it's probably best that they're relegated to this system.



3 MORE COOLING OPTIONS

What you're looking at here are the two Silent Wings fans included with the Silent Loop 240mm AIO. However, they're actually optimised more for airflow than static pressure. So instead of mounting them on the cooler, we popped them on top to, act as exhausts — and utilised a whole plethora of Silent Wings 3s for the AIO instead. One of the more impressive inclusions with the Eclipse P400S is the multiple options for cooling. By default, the case comes with two magnetic white plastic vent covers. You can pull these off for unfettered airflow and more fan mounts, and leave it open, or attach the two 140mm magnetic dust filters that Phanteks has included with the case.



4 CHILLINGLY SLEEK

And here are those two magnetic dust filters we spoke about earlier, sitting proud and true. You can mount two 140mm fans here, but because OCD is a massive thing for this particular writer, keeping the fan branding consistent is key. We also couldn't mount the AIO in the roof, because the X99 TUF Sabertooth is a fairly chunky piece of gear. And with the CPU power in the way, it's impossible to mount the AIO there with this particular combination of parts. To compensate, we decided to ramp up the cooling with push/pull on the AIO instead.



4 REAR I/O GALORE

A big consideration when it came to choosing the X99 TUF Sabertooth was I/O. To give you an idea of the setup, we have Ethernet going in for internet, one local WD My Cloud NAS network, a Logitech C930e webcam, a Razer Chroma keyboard, Mionix Castor mouse, external hard drive, SteelSeries Siberia 840 headset wireless hub, a Samsung Wireless Qi Charger and two DisplayPort screen outputs as well. On top of that, from time to time, USB sticks, additional external hard drives, and peripherals that we're testing are all plugged into the hard-working machine. The Sabertooth and GTX 1080 Ti combine to provide more than enough I/O for that profusion of gear.



6 NOISE DAMPENING

Here's the front panel detached from the chassis. You can spot the two tiny removable fan filters located at the top and the bottom, providing both easy maintenance and cleaning, and sufficient filtration. You may also notice the sound dampening material lining the front panel. It can also be found on the rear side panel, and the two plastic roof covers — if you decide to keep them in, of course. The tempered glass acts as suitable noise dampening as well, helping to keep the humming of whatever fans you install to a minimum.



- 1 We stuck the LED strip along the top of the case. It lights up the build a treat, and is controlled via a button on the front of the case.
- 2 The PSU cover may be very basic, but we're not sure we'd invest in a case without one.
- 3 The armour hiding the PCIe M.2 SSD has always been a favourite feature of ours and one of the neater details of the X99 TUF.
- 4 32GB of DDR4 feels like the standard for any HEDT build today, especially if you're looking to do a bit of everything.

"It's definitely an upgrade over what we had prior to this, and it performs great, outside of the ecosystem."

Ready for work

This system was built to do anything and everything. Whether that's casual gaming, testing benchmarks, web browsing, media editing, general office stuff... you name it, it can do it proficiently and efficiently. Arguably, the old system would have done this as well – but as competently? Not likely. In today's era of Ryzen multicore processors and PCIe SSDs, however, it would have made more sense to go out and buy a Ryzen 7 1700 and something of equal calibre for the motherboard, if you were building this yourself. But that's not something we have the luxury of doing in the office.

The build itself was relatively unchallenging (outside of the socket needing a bit of love). Working inside

the P400S was exceptionally enjoyable. We can't emphasise enough how impressive this case is as a value offering. You could pay \$120 for this thing, and still feel as though you're getting a good deal. Mounting any AIO radiator, fans first, is always challenging, so that's something to look out for, especially if you're considering a push/pull orientation, because you have to thread the long bolts through the fans, then into the threads of the radiator, without necessarily being able to see them. It can take a few attempts to get it right, but that's about the only awkward part of the entire build.

And then there's the performance. It's definitely an upgrade over what

we had prior to this, and it performs great, outside of the ecosystem. Compare it against Ryzen and any modern offerings, however, and the chinks in the armor start emerging. The PCIe SSD, although providing fantastic reads, is a little lackluster on the writes, and the CPU rendering performance, although impressive, lacks substance in contrast to its Ryzen counterpart. Admittedly, video rendering isn't something we do on a day-to-day basis, but when we do, we need it done ASAP.

Graphics is where it's at, though. And the GTX 1080 Ti is the king of the hill right now. However, it's in rather an odd position as a card, because it seems like good value, but only thanks to Nvidia artificially creating that market – AMD has yet to provide any substantial form of competition at the high end. It's cheaper than a Titan Xp by an incredible margin, while touting very similar performance, and it's leaps and bounds more powerful than its GTX 1080 predecessor, by a factor of almost 30–40% in most cases – for only \$200 more. You feel like you're getting a good deal, but in reality, if AMD were actually competitive right now, seeing this card at \$600–700 wouldn't seem like such a huge shock. In this build, it dominates our testing suite at 1080p, as is to be expected. And it makes gaming at 1440p during lunchbreaks particularly enjoyable. ■

BENCHMARK RESULTS

	APC LABS TEST PC	THIS PC
CINEBENCH R15 MULTI-THREAD	987	1,213 (23%)
CINEBENCH R15 SINGLE-THREAD	196	164 (-16%)
TECHARP'S X264 HD 5.0.1 (FPS)		26.93 (23%)
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)	1,895	2,150 (13%)
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)	949	400 (-58%)
RISE OF THE TOMB RAIDER (FPS)	76	93 (22%)
FAR CRY PRIMAL (FPS)	72	113 (57%)
THE DIVISION (FPS)	42	132 (214%)

Our Labs test desktop PC uses a Core i7-6700K CPU @ 4.6GHz, an AMD R9 Fury X and 32GB of RAM. All games are tested at 1080p on max settings, with HD texture packages installed.

Prolong your Raspberry Pi SD card's lifespan

Use a few tweaks and USB-booting to prolong your SD card and avoid losing important Raspberry Pi projects.

At some point during the lifetime of your Raspberry Pi, you're likely to encounter a problem with your SD or microSD card. If you're lucky, this will be minimal—perhaps a reboot will fix it. If you're unlucky, it could mean the end of your SD card and the loss of all data on your Pi, including your latest project.

The simple fact is that SD cards do not last forever. Flash storage, by design, has a limited number of read/write cycles. While error-correction software is built-in and cards ship with larger-than-described storage to cover damaged blocks, eventually corruption will cause a problem.

SD card corruption occurs in various ways. It might be due to a sudden variation in voltage during a read/write cycle or from being removed from the Raspberry Pi. Flash storage is also susceptible to extreme temperatures and physical damage. Cheap SD cards, meanwhile, are usually unreliable; whatever the situation, you should rely on the more expensive cards from SanDisk or Kingston.

While it might be useful to regularly back up your flash storage to enable quick recovery, a more proactive option is to bypass the SD card entirely by relying on other storage mediums for booting the Raspberry Pi, but you should also be aware of various tools that can be used to protect your microSD card.

1 DON'T FLASH A FRESH OS FOR EVERY PROJECT

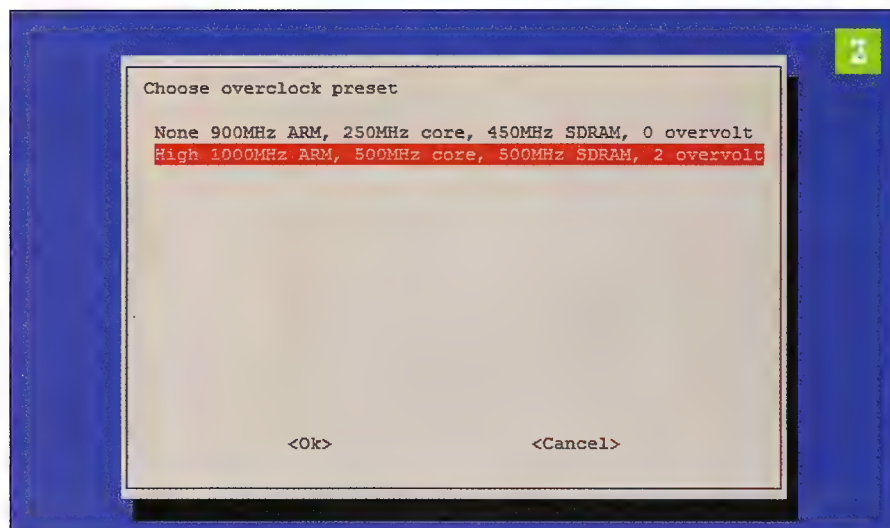
The read/write cycle limit is a physical hardware restriction preventing infinite reuse of an SD card. So look after it! While 'swappiness' (the kernel parameter defining how much and often RAM is copied to storage) is apparently set low in Raspbian, there is more you can do.

One way to extend the lifespan of the device is to avoid flashing a fresh version of Raspbian (or whatever your preferred OS is) every single time you start a new project.

Doing so applies a card-wide reduction in the remaining read-write



```
pi@raspberrypi:~ $ sudo apt-get remove dnsmasq
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages were automatically installed and are no longer required:
  dns-root-data dnsmasq-base libmnl0 libnetfilter-conntrack3
Use 'apt-get autoremove' to remove them.
The following packages will be REMOVED:
  dnsmasq
0 upgraded, 0 newly installed, 1 to remove and 71 not upgraded.
After this operation, 117 kB disk space will be freed.
Do you want to continue? [Y/n] y
(Reading database ... 31388 files and directories currently installed.)
Removing dnsmasq (2.72-3+deb8u1) ...
pi@raspberrypi:~ $
```



cycles. So by maintaining a working microSD card throughout several projects, you avoid the effect that regular flashing has on the card.

This is not a perfect solution, but it will help you get projects started without the initial flashing and configuration that is typically required. Need to keep things tidy? Remove software with `sudo apt-get remove APPNAME`. This will uninstall the software you no longer need, but may be time-consuming. In short, only flash Raspbian when you really must.

2 MAINTAIN A CONSTANT POWER SUPPLY

A reliable power supply is a major aspect in the preservation of your Raspberry Pi's SD storage. If there's much variation, data can be lost, ultimately causing corruption of the card. At this point, your Pi probably won't boot, and a new OS will need flashing.

The Pi requires a constant voltage of 5V. This is available via the approved mains adaptors, but keep in mind that these devices cannot account for failings in the sockets they're plugged into. Don't use cheap extension leads. Instead, ensure your mains adaptor is connected either to the wall (if you have modern surge protection built in) or otherwise to an extension with surge protection.

It's common to attempt to squeeze as much power out of a Raspberry Pi through overclocking, but this too is a possible cause of disk corruption. Rather than go through the rigmarole – and card-degrading – act of flashing a new ROM, it's safer to avoid overclocking the Pi's CPU if you want to maintain a stable system.

3 WRITE TO RAM, NOT STORAGE

A great way to reduce the number of read/write cycles on your SD card is to not write to it in the first place. This doesn't mean leaving your Pi powered off! Instead, you can write everything to the computer's RAM. As such, nothing will be written to the microSD card, thereby extending its life. Better still, this is easy to set up using `tmpfs`. Begin by opening the `fstab` in `nano` with `sudo nano /etc/fstab`. At the bottom of the file, add this line:

```
tmpfs /var/log tmpfs
defaults,noatime,nosuid,
mode=0755,size=100m 0 0
```

Press `Ctrl-X` to exit and save. This moves the `/var/log` directory to RAM, reducing the microSD card's read/write cycles. Other locations can be safely moved to RAM too:

```
tmpfs /tmp tmpfs
defaults,noatime,nosuid,size=
=100m 0 0
tmpfs /var/tmp tmpfs
defaults,noatime,nosuid
size=30m 0 0
tmpfs /var/log
tmpfsdefaults,noatime,nosuid,mo
de=0755,size=100m 0 0
tmpfs /var/run tmpfs
defaults,noatime,nosuid,
mode=0755,size=2m 0 0 tmpfs /
var/spool/mqueue
tmpfs defaults,noatime,nosuid,
mode=0700,gid=12,si
ze=30m 0 0
```

Beware: this will only last until you reboot your Pi, at which point, everything is cleared from RAM.

4 BOOT YOUR PI FROM A USB STICK

Recent updates to Raspbian enable you to boot a Raspberry Pi 3 via an attached USB device (a flash drive, standard HDD or even an SSD), bypassing the microSD card entirely.

Via SSH, begin with:

```
sudo apt-get update
sudo BRANCH=next rpi-update
```

Then enable USB boot mode:

```
echo program_usb_boot_
mode=1 | sudo tee -a
boot/config.txt
```

With the `'program_usb_boot_mode=1'` instruction added to the end of the `config.txt` file, reboot with `sudo reboot`.

When the Pi restarts, you'll need to check if the one-time programmable (OTP) memory has been changed.

```
vcgencmd otp_dump | grep
17:
```

If the previous steps have been successful, you should see something like `'0x3020000a'` (pictured, below). Your Raspberry Pi is now ready to boot from a USB device, so connect the one that you want to use; but note that it

"SD cards do not last forever. Flash storage has a limited number of read/write cycles."

```
pi@raspberrypi:~$ vcgencmd otp_dump | grep 17
17:3020000a
pi@raspberrypi:~$
```

```
proc /proc defaults 0 0
/dev/mmcblk0p1 /boot vfat defaults 0 2
/dev/mmcblk0p2 / ext4 defaults,noatime 0 1
# a swapfile is not a swap partition, no line here
# use dphys-swapfile swap[on|off] for that
tmpfs /var/log tmpfs defaults,noatime,nosuid,mode=0755,size=100m 0 0
```

```
File system type? [ext2]? ^Z
[1]+ Stopped sudo parted /dev/sda
pi@raspberrypi:~$ sudo parted /dev/sda
GNU Parted 3.2
Using /dev/sda
Welcome to GNU Parted! Type 'help' to view a list of commands.
(parted) mktable msdos
Warning: The existing disk label on /dev/sda will be destroyed and all data on
this disk will be lost. Do you want to continue?
Yes/No? yes
(parted) mkpart primary fat32 0% 100M
(parted) mkpart primary ext4 100M 100%
(parted) print
Model: SanDisk Cruzer Fit (scsi)
Disk /dev/sda: 32.0GB
Sector size (logical/physical): 512B/512B
Partition Table: msdos
Disk Flags:

Number Start End Size Type File system Flags
 1 1049KB 99.6MB 98.6MB primary fat32 lba
 2 99.6MB 32.0GB 31.9GB primary ext4 lba

(parted)
```


how to » raspberry pi masterclass

```
pi@raspberrypi: /mnt/target
File Edit View Search Terminal Help
pi@raspberrypi: /mnt/target $ sudo sed -i "s,root=/dev/mmcblk0p2,root=/dev/sda2,"
/mnt/target/boot/cmdline.txt
pi@raspberrypi: /mnt/target $ sudo sed -i "s,/dev/mmcblk0p,/dev/sda," /mnt/target
/etc/fstab
pi@raspberrypi: /mnt/target $
```

```
140,095 100% 422.26kB/s 0:00:00 (xfr#27431, to-chk=13/35841)
var/log/wtmp 9,216 100% 27.52kB/s 0:00:00 (xfr#27432, to-chk=12/35841)
var/log/apt/ 11,369 100% 33.75kB/s 0:00:00 (xfr#27433, to-chk=7/35841)
var/log/apt/history.log 91,006 100% 263.72kB/s 0:00:00 (xfr#27434, to-chk=6/35841)
var/log/apt/term.log 31 100% 0.09kB/s 0:00:00 (xfr#27435, to-chk=5/35841)
var/log/fsck/checkfs 31 100% 0.09kB/s 0:00:00 (xfr#27436, to-chk=4/35841)
var/log/fsck/checkroot
var/log/ntpstats/
var/log/samba/
var/mail/
var/opt/
var/spool/
var/spool/mail -> ../mail
var/spool/cron/
var/spool/cron/crontabs/
var/spool/rsyslog/
var/tmp/
pi@raspberrypi:~$
```

```
pi@raspberrypi:~$ ip route | grep default | awk '{print $3}'
192.168.0.1
pi@raspberrypi:~$ ip -4 addr show dev eth0 | grep inet
inet 192.168.0.40/24 brd 192.168.0.255 scope global eth0
pi@raspberrypi:~$
```

will be reformatted. You can identify your USB device with `lsblk`, which will list all block devices.

Connected USB devices are usually called 'sda'. Enter the following to unmount the device and run the `Parted` tool:

```
sudo umount /dev/sda
sudo parted /dev/sda
```

This will take you to the `Parted` prompt.

5 COPY RASPBIAN TO YOUR USB DRIVE

At the prompt, enter:

```
mkpart primary fat32 0%
100M
mkpart primary ext4 100M
100%
print
```

Then use `Ctrl-C` to exit. Back at the command prompt, you will need to create both a new boot filesystem and root filesystem:

```
sudo mkfs.vfat -n BOOT -F
32 /dev/sda1
sudo mkfs.ext4 /dev/sda2
```

Next, mount the target filesystems:

```
sudo mkdir /mnt/target
sudo mount /dev/sda2 /mnt/
```

```
target/
sudo mkdir /mnt/target/boot
sudo mount /dev/sda1 /mnt/
target/boot/
sudo apt-get update; sudo
apt-get install
rsync
```

Copy Raspbian to your USB with:

```
sudo rsync -ax --progress /
/boot /mnt
target
```

This will take a while to complete, so leave it to finish. Once done, you'll need to copy the SSH host keys from the microSD card to the USB device to maintain the connection via SSH. Enter the following line at a time.

```
cd /mnt/target
sudo mount --bind /dev dev
sudo mount --bind /sys sys
sudo mount --bind /proc
proc
sudo chroot /mnt/target
rm /etc/ssh/ssh_host*
dpkg-reconfigure openssh-
server
exit
sudo umount dev
sudo umount sys
sudo umount proc
```

6 PREPARE TO BOOT FROM USB

Before you reboot your Pi from

the USB device, edit the `cmdline.txt` file again in the terminal:

```
sudo sed -i "s,root=/dev/
mmcblk0p2,root=/dev
sda2," /mnt/target/boot/
cmdline.txt
```

A similar change must also be made to `/etc/fstab`:

```
sudo sed -i "s,/dev/
mmcblk0p,/dev/sda," /mnt
target/etc/fstab
```

You're now ready to unmount the filesystem:

```
cd ~
sudo umount /mnt/target/
boot
sudo umount /mnt/target
```

At this stage, you can enter the `poweroff` command to shut down your Pi. Once the lights are off, disconnect the power supply and remove the microSD card. A few minutes later, you can reconnect the power and boot your Pi – from the USB device!

Your microSD card is now guaranteed a much longer lifespan. You might retain the Raspbian image, however, for preparing other Pis for USB booting in future.

Better still, this means that you can have as much storage as possible for your Raspberry Pi. USB flash usually stops around the 512GB capacity (although there are larger devices) while mechanical hard disk drives can potentially add terabytes of storage to your Pi. Alternatively, an SSD device will speed things up considerably.

7 BOOT RASPBIAN ACROSS YOUR NETWORK

Booting from USB can be taken to the next level – network boot. Using a Pi as a server, you can set up a Raspberry Pi 3 with Raspbian Lite and set it to initially boot from USB. With the server and new client configured correctly, the Pi can boot from the network, again reducing the impact on the SD card.

On your intended client, follow the previous steps up to the point of removing program `usb_boot_mode` from `/boot/config.txt`, then running the `poweroff` command.

Next, remove the SD card and insert it into the Pi you'll be using as a server. Boot this device, then run `sudo raspi-config`. This will open the configuration options. Select the `Expand Filesystem` option. Then create a copy of the root filesystem:

```
sudo mkdir -p /nfs/client1
```



```
sudo apt-get install rsync
sudo rsync -xa --progress
--exclude /nfs /nfs/client1
```

This will take a while to complete, so be patient!

8 FIND THE ADDRESSES

Continue by maintaining your connection via SSH, by regenerating the SSH host keys:

```
cd /nfs/client1
sudo mount --bind /dev dev
sudo mount --bind /sys sys
sudo mount --bind /proc proc
sudo chroot .
rm /etc/ssh/ssh_host_*
dpkg-reconfigure openssh-server
exit
sudo umount dev
sudo umount sys
sudo umount proc
```

Then find the address of your router. If you don't know this, run:

```
ip route | grep default |
awk '{print $3}'
```

Check your Pi's own IP address with:

```
ip -4 addr show dev eth0 |
grep inet
```

Then use `cat /etc/resolv.conf` to find the address of your DNS server. You should now have your device's IP, broadcast and DNS server addresses, so note these down. Run `sudo nano /etc/network/interfaces` and edit the line `iface eth0 inet manual` so that it reads:

```
auto eth0
iface eth0 inet static
address [YOUR_IP_ADDRESS]
netmask 255.255.255.0
gateway [YOUR_BROADCAST_
ADDRESS]
```

Press `Ctrl-X` to save and exit. To make this work, you'll need to disable DHCP networking, so run the following and then reboot your Pi:

```
sudo systemctl disable
dhcpcd
sudo systemctl enable
networking
```

9 CONFIGURE YOUR SERVER'S NETWORK SETTINGS

Enter the following with the DNS IP address you noted earlier.

```
echo "nameserver [YOUR_
NAMESERVER_IP]" | sudo tee -a
/etc/resolv.conf
```

```
port=0
dhcp-range=[YOUR_BROADCAST_IP],proxy
log-dhcp
enable-tftp
tftp-root=/tftpboot
pxe-service=0,"Raspberry Pi Boot"
```

```
proc /proc proc defaults 0
/dev/mmcblk0p1 /boot vfat defaults 0
/dev/mmcblk0p2 / ext4 defaults,noatime 0
# a swapfile is not a swap partition, no line here
# use dphys-swapfile swap[on|off] for that
```

Prevent changes to this with:

```
sudo chattr +i /etc/
resolv.conf
```

You then need to install some software:

```
sudo apt-get update
sudo apt-get install
dnsmasq tcpdump
```

The `dnsmasq` tool can cause problems, so prevent this with:

```
sudo rm /etc/resolvconf/
update.d/dnsmasq
```

Reboot again, then run `tcpdump` to detect DHCP from the client Pi.

```
sudo tcpdump -i eth0 port
bootpc -v
```

At this stage, connect the client Pi to the network via Ethernet, and connect the power cable. After 10 seconds, the LEDs should light, and a packet from the client will be received by the server and displayed in the `tcpdump` tool. Press `Ctrl-C` to exit, then enter:

```
sudo echo | sudo tee /etc/
dnsmasq.conf
sudo nano /etc/dnsmasq.
conf
```

Delete everything in the file and add:

```
port=0
dhcp-range=[YOUR_
BROADCAST_IP],proxy
log-dhcp
enable-tftp
tftp-root=/tftpboot
pxe-service=0,"Raspberry
Pi Boot"
```

Next, create a new directory, `tftpboot`:

```
sudo mkdir /tftpboot
sudo chmod 777 /tftpboot
sudo systemctl enable
```

```
dnsmasq.service
sudo systemctl restart
dnsmasq.service
```

10 PREPARE FOR NETWORK BOOT

Continue by monitoring the `dnsmasq` log with:

```
tail -f /var/log/daemon.
log
```

If working, a 'not found' message will be displayed. Copy the necessary files with `cp -r /boot/* /tftpboot`.

Then restart `dnsmasq` with `sudo systemctl restart dnsmasq` and the client Pi is ready to boot the root filesystem and then boot from the network. The `/nfs/client1` filesystem must now be exported:

```
sudo apt-get install
nfs-kernel-server
echo "/nfs/client1
*(rw,sync,no_subtree
check,no_root_squash)" |
sudo tee -a /etc/
exports
sudo systemctl enable
rpcbind
sudo systemctl restart
rpcbind
sudo systemctl enable
nfs-kernel-server
sudo systemctl restart
nfs-kernel-server
```

Next, edit `/tftpboot/cmdline.txt`, changing the line beginning `'root='` to:

```
root=/dev/nfs
nfsroot=[YOUR_DEVICE_IP]:/nfs
client1 rw ip=dhcp rootwait
elevator=deadline
```

Open `fstab` with `sudo nano /nfs/client1/etc/fstab` and remove the `'/dev/mmcblkp1'` and `'/dev/mmcblkp2'` lines. You're done! Now start the client and wait for it to boot from the network. This may be a little slower than what you're used to (depending on your network speed), but will extend the life of your Pi's microSD card considerably. ■

A beginner's guide to car hacking with Android

Modern cars are powered by computers, but new wireless hardware can let you peak inside through On-Board Diagnostics and your Android phone. Darren Yates explains.

If you drive a car exceeding a certain age (five years in NSW), you'll be familiar with the yearly trek to your local mechanic to have the registration safety and roadworthiness check – the 'e-safety check' – performed. While the check invariably requires a once-over of tyres and correct operation of all exterior indicator lights, the mechanic is also required to check your vehicle's brakes. For most cars built in the last 15 years, it's a relatively easy affair, thanks to a socket hidden under the dashboard near the driver's side front door. This socket allows professional hand-held instruments to read diagnostics codes and real-time data from the vehicle's engine control unit (ECU) about almost everything that's going on, from fuel pressure to engine RPM. Now thanks to low-cost Bluetooth scanners, you can read much the same real-time engine data with your Android phone.

OBDD-II INTERFACE

In 1996, the US mandated that all cars sold in the country's market required an on-board diagnostics (OBD) interface to read the car's ECU codes and data. Today, OBD-II is a worldwide compliance standard and supported on Australian vehicles going back as far as 1999 and the Holden VT Commodore. However, local OBD-II support start dates vary between manufacturer and model, so you'll need to investigate your car independently.

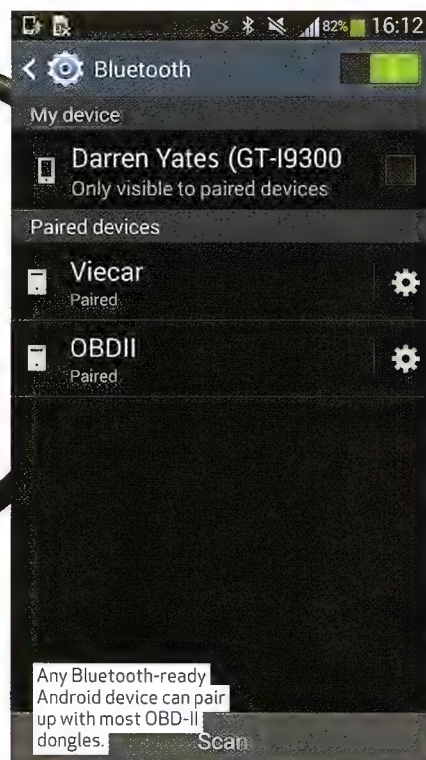
While it not only allows you to read data from the dozens of sensors floating around your vehicle's engine bay, OBD-II also allows a mechanic to diagnose vehicle error or 'diagnostic trouble codes' (DTCs) that otherwise appear as a mostly-meaningless engine warning light on your dashboard. The OBD-II port itself is known as a data link connector (DLC) and you'll typically find it under the dashboard between the driver's side door and the steering column.

HOW OBD-II WORKS

The 16-pin DLC interface electrically links to the ECU via an RS232-like serial bus and to access data, you essentially send two eight-bit hexadecimal numbers – one for 'mode', the other for 'PID' (parameter ID). The mode determines the type of data you want returned and the PID, the specific data itself. For example, to get real-time data on the current engine RPM (revolutions per minute), you send 0x1/0xC – 0x1 for Mode 1 (current data) and 0xC, the PID for 'engine RPM'. This command returns a two-byte data field that is converted back to RPM values up to a maximum of 16,384rpm. Want current vehicle speed? You send 0x1/0xD, where 0x1 is Mode 1 as before and 0xD is the PID for speed, returned as a single byte for a maximum reading of 255km/h.

The combined mode/PID list is extensive and too much for us to cover here – you can get an idea of its breadth over at en.wikipedia.org/wiki/OBD-II_PIDs.

More professional scanners like this Bosch OBD 1100 sell for around \$200.



WHY OBD-II MATTERS

As more and more cars began featuring ECUs, they each came with their own interface standard, making it a nightmare for mechanics and others to keep track of who was who in the zoo, particularly when it came to signal protocols. By 1991, the first On-Board Diagnostics standard (which eventually became known as 'OBD-I') was mandated in vehicles to offer basic diagnostic data access. However, there were no data signal protocols or connection standards included, so it was still a messy system.

Not long after, vehicle exhaust emissions testing began to receive serious consideration in the US and that's when a more comprehensive standard in OBD-II came into force for cars in 1996. Having a single, unified interface system that covered all of the various protocols was vital if simplified engine servicing and testing was to become a reality.

Officially, there are five signal protocols now available for use on an OBD-II interface:

- SAE J1850 PWM (pulse-width modulation)
- SAE J1850 VPW (variable pulse width)
- ISO 9141-2 (similar to RS232)
- ISO 14230-4 KWP (keyword protocol)
- ISO 15765-4 CAN (controller area network)

On top of that, you also have variations in ID bit length and data transmission speeds. When it comes to official documentation, there are dozens of ISO (International Organisation for Standardisation) and SAE (Society of Automotive Engineers)

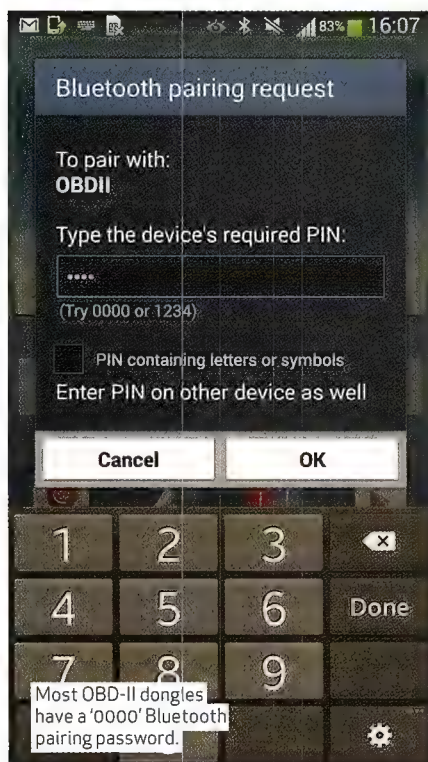


The ELM327 dongle powers up as soon as you plug it into the OBD-II socket.

"While it not only allows you to read data from the dozens of sensors floating around your vehicle's engine bay, OBD-II also allows a mechanic to diagnose vehicle error or 'diagnostic trouble codes' (DTCs) that otherwise appear as a mostly-meaningless engine warning light on your dashboard."

standards that refer to OBD-II and the combinations of protocol, speed and additional diagnostic functions added to previous versions. Even so, vehicle manufacturers reportedly don't have to support all PIDs and each car manufacturer also has its own

additional PID sets. As a result, professional diagnostic tools, like those used by your mechanic for rego checks, have been around for the much of the past two decades. But more recently, low-cost alternatives have become available to consumers and hobbyists, although the technology behind a number of these devices appears to have a murky back-story.



Most OBD-II dongles have a '0000' Bluetooth pairing password.



The ELM327 clone reading my car's revolutions per minute (RPM) counter.

ELM327 MICROCONTROLLER

One of the earliest and most popular consumer-grade solutions to hit the market came courtesy of Canada's ELM Electronics (elmelectronics.com). The company creates its own chips that read the different OBD standard codes from the different car makers. One of those chips was dubbed the 'ELM327', which, reports suggest, is actually an ELM-programmed Microchip PIC32 microcontroller. Unfortunately, it seems the company didn't set the copy-protection bit of the original 'version 1.0' batch of chips and that allowed hackers to read the op-codes from the chip and use it to create their own clones. Since then, eBay has been awash with ELM327-branded dongle clones selling for as little as US\$3 and competition being what it is, soon version 1.5 and even version 2.1 models began appearing. The only problem is, in many cases, they're just copies of this original v1.0 code, warts and all. ELM Electronics still develops its source



The OBD-II port is under the dash between the door and steering column.



The Viacar dongle won't start until you press the power button.

"You can buy OBD-II clones that are hard-wired via USB, but the cheapest models feature Bluetooth only — still, that allows you to combine them with your Android device, thanks to the growing number of OBD-II apps available on Google Play."

A Viacar VC004A OBD Bluetooth dongle purchased on eBay for about \$5.



This no-name \$5 'OBDII' ELM327 Bluetooth dongle came from eBay.



code and manufactures its own chips (it recently released version 2.2), you'll also find genuine ELM327-powered devices on the market. So the question is how can you tell if you're getting a genuine ELM327 chip or a copy? Simple — if it costs you less than US\$21, it's a pretty safe bet it's a copy, for that's the price of a genuine ELM327 chip from ELM Electronics. The other giveaway is that the company doesn't sell v1.5 or v2.1 versions.

But before you go around screaming 'fake chips', just be aware that, in the electronics industry, there are degrees of 'fake' and it's a term thrown around a bit too freely. These ELM327 clones might not be genuine, but they appear to work. If you call that 'fake', so be it. But there are worse 'fakes' in the electronics industry — try 'fake ICs' (integrated circuits) that are nothing more than blobs of plastic some refer to as 'slugs'. For example, popular retailer SparkFun Electronics was stung with a reel of dud ATMEGA328 microcontrollers (chips used in the popular Arduino Uno DIY boards) back in 2010 at a time when this chip was apparently in short supply. When the SparkFun team investigated, these chips had nothing inside them (sparkfun.com/news/350).

But then on the other hand, I've seen people dub as 'fake' other chips legitimately manufactured under license by secondary manufacturers that perform exactly the same as the original. It's hard to see these low-cost ELM327 clones falling into this category — but it still suggests you need to tread with some caution.

HOW OBD-II DONGLES WORK

We purchased two units for this story — a generic blue 'ELM327' Bluetooth dongle for about \$5 on eBay, plus a second similar unit, a Viacar VC004-A, with the same styling but added power button for around the same price. The blue dongle identified itself on Bluetooth as 'OBDII', while the Viacar dongle simply came up as 'vicar'.

In both cases, the dongle plugs straight into the OBD-II/DLC interface port and, even with the engine off and no keys in the ignition, both had power — the OBDII dongle powers up straight away, while the Viacar model requires you press its power button.

ANDROID SOFTWARE

You can buy OBD-II clones that are hard-wired via USB, but the cheapest models feature Bluetooth only — still, that allows you to combine them with your Android device, thanks to the growing number of OBD-II ready apps available on Google Play.

We think the best of them is Ian Hawkins' Torque, but we also reckon your first stop should be ELM327

Identifier (tinyurl.com/lfa7zz6). This simple app pairs your Android device with your ELM327 clone plugged into your vehicle to check the firmware version and just which of the genuine ELM OBD-II features are supported.

We used this app to test our two units – the blue ‘ELM327/OBDII’ dongle identified itself as having ‘ELM327 v2.1’ firmware, while the Viacar VC004-A had seemingly-older ‘ELM327 v1.5’ code. However, what we found interesting about this is that, despite its older version code, the VC004-A actually had greater OBD-II function support, according to the ELM327 Identifier app.

Beyond that, to get real-time and logged data from your vehicle’s ECU, we think Torque is the app you want. There’s a free version called Torque Lite (tinyurl.com/cdjtljp), which is ideal to start with and loaded with plenty of features, but the \$5 full version has bucketloads more. The first time you use Torque, you’ll get basic information from the ELM327 dongle, even with your vehicle’s ignition off, but the features list obviously comes alive when you fire up the ignition and the vehicle’s ECU kicks in – and that list is quite long. What’s more, Torque gives you excellent configuration options – you’ve got seven swipe screens, each of which can feature dials or graphs. You can move features around and even change their size. Torque isn’t the only option either – search Google Play for ‘OBD2’ and you’ll find plenty of apps, but we think Torque should top your list.

WHAT ABOUT HACKING?

OK, given these low-cost scanners are essentially read-only, the hacking you can do with them is more virtual – by graphing how you drive, you can learn, for example, that hard acceleration from a standing-start creates serious spikes in fuel consumption and by easing your way off the mark, you can reduce that consumption. If you drive a manual, you’d also likely be able to work out the optimum RPM point for changing gears, by comparing RPM with fuel consumption. So in effect, this is about hacking you as a driver and improving your skills.

However, it’s also possible to read, as well as reset error codes that light up your dashboard’s engine fault light using an ELM327-style dongle and the Torque Lite app.

GETTING SERIOUS

But that’s not to say serious vehicle hacking can’t be done. Once you get past the low-cost read-only scanners, you move into full-on modding territory or ‘chip-tuning’, where you can make serious changes to engine function, for example, fudging the air intake temperature to change the fuel flow-rate and make the engine generate

more power. However, just be aware that incorrect tampering with your vehicle’s ECU could cause all sorts of trouble, including extremely serious engine damage. There are numerous professional services out there that will tune or ‘remap’ your car’s ECU, but just be sure you’re fully aware of the risks involved before you proceed.

SECURITY

One thing we wouldn’t recommend with these low-cost dongles is to leave them plugged into your car – not because they might fail as a result of heat, or eventually bleed your battery dry, but because of their essentially non-existent security. Think about it – a Bluetooth-connected dongle tapping into your car’s ECU with a password of ‘0000’ or ‘1234’? It just isn’t worth the risk. Sure, these devices are meant to be ‘read-only’ and, in most cars, they’ll be out of sight under the dashboard and won’t work if your car’s ignition is switched off. But frankly, there’s no such thing as ‘100% guaranteed security’, so why leave the crooks an opening?

And yep, it might sound like we’re calling for the tin hats on this, but the reality is there are known denial of service (DoS) attacks already possible over ODB-II and an interesting white paper from the Software Engineering Institute of Carnegie Mellon University highlights the potential security issues (tinyurl.com/yaa59tn9, PDF).

All we’re saying is that it’s better to be safe than sorry.

BUYER BEWARE

So there it is – the tools for scanning ECU codes from your set of wheels are as close as eBay and your Android phone. Are they perfectly safe for your car? The cheap ELM327 clone scanners are only supposed to read data from your ECU, not write to it beyond clearing DTCs and plenty of reviews suggest users swear by them (rather than ‘at’ them). All we can say is we’ve tried two different units on a 2005 Mazda 3 sedan and we’ve seen no ill effects so far. Beyond that, though, it’s definitely ‘buyer beware’.

“One thing we wouldn’t recommend with these low-cost dongles is to leave them plugged into your car – not because they might fail as a result of heat, or eventually bleed your battery dry, but because of their essentially non-existent security.”



Make an Arduino garage parking assistant

Ease the squeeze when parking your vehicle and make your own Arduino-powered garage parking assistant. Darren Yates explains how it works.

One of the great things about making your own tech is that any time you run into a problem, you can build your own solution. This month, we're solving the perennial parking problem by turning an Arduino Nano board, an ultrasonic sensor, an LED, a piezo-buzzer plus other odds and ends into an automated garage parking assistant.

MEASURING DISTANCE

Many garages and parking spaces are pretty tight these days and if you're always struggling to judge just how far away you are from bending your fender, take the guesswork out of it and put some science in instead. One way you can do that is to use an ultrasonic rangefinder sensor that's capable of measuring distances of up to 2m with quite reasonable accuracy (more than you'll need).

But by combining that ultrasonic sensor with an Arduino Nano microcontroller, a buzzer and a high-brightness LED, you can create a simple three-tiered light-and-sound warning system. When the first warning distance is crossed, it flashes the LED and sounds the buzzer at half-second intervals, crossing the second warning distance sets them off at a more urgent 150 milliseconds and the third runs them continuously.

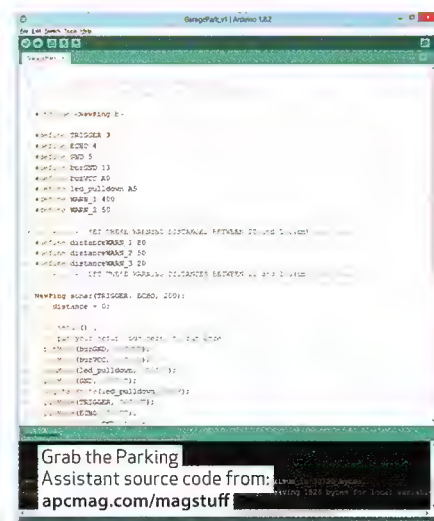
The HC-SR04 ultrasonic sensor is very easy to program thanks to the excellent NewPing code library and does the hard work of measuring the time between sending each ultrasonic pulse and receiving the return echo – all we have to do is use NewPing to return the distance in centimetres between the sensor and whatever object (ideally, your vehicle) is in front of it. We then compare that distance with the three warning distance levels and set off the appropriate light-and-sound warning.

All up, it's a pretty simple design, but then, why complicate things if you don't have to?

BUILDING THE PARKING ASSISTANT

How you build yours is really up to you, but we built our prototype on a simple tiny 170-tiepoint breadboard. The Arduino Nano board sits towards one edge of the breadboard and the HC-SR04 sensor plugs into pins D2 to D5. Do that and you should find the sensor is positioned sweetly on the breadboard edge as if it was built for it.

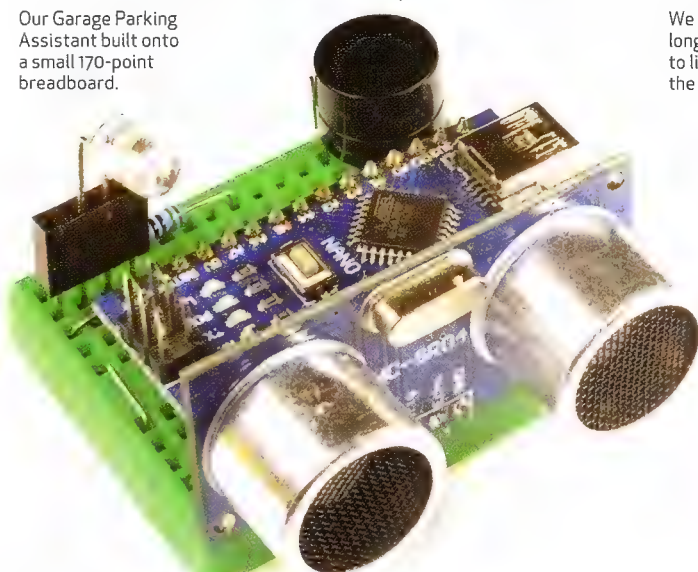
The 150-ohm current-limiting resistor protects both the Nano's A5 output circuitry, as well as the high-brightness LED from blowing themselves up by limiting the current to approximately 15–20 milliamps, depending on the forward voltage drop of the LED you use.



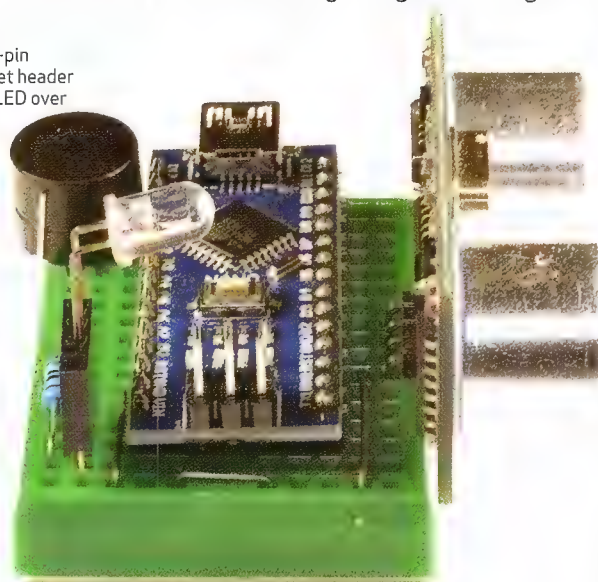
We've also incorporated a 5VDC piezo buzzer, which slots in nicely between pins D13 and A0. Now the only problem with this buzzer is, depending on the size of your gas-guzzler, the buzzer may not be loud enough to hear above the din of your vehicle's engine. In that case, you can use the A0 pin as a control trigger to feed a more powerful buzzer (note, the output doesn't have enough drive to handle most buzzers directly).

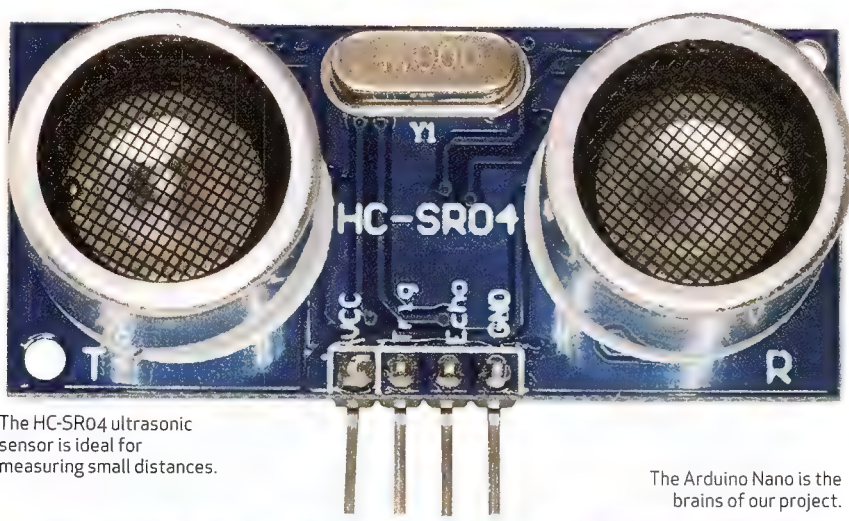
The high-brightness LED is lifted up using a four-pin socket header (we couldn't find a two-pin one) and the LED leads bent at right-angles so the light

Our Garage Parking Assistant built onto a small 170-point breadboard.



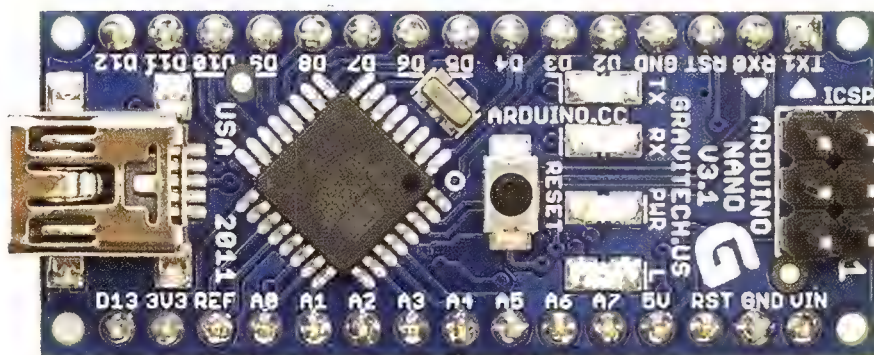
We use a four-pin long-leg socket header to lift up the LED over the HC-SR04.





The HC-SR04 ultrasonic sensor is ideal for measuring small distances.

The Arduino Nano is the brains of our project.



flashes forward. The whole thing can be powered through the Arduino Nano's miniUSB port. Just follow the overlay diagram and you should be pretty right. We purchased everything from eBay.

If you have skills, you can easily build this onto some veroboard DIY circuit board and put the whole thing inside a small box for a more permanent installation.

FLASHING THE CODE

There's a few things to do before we get to flashing the code into the Arduino board, so start by downloading the source code from our website (apcmag.com/magstuff). If you don't have the Arduino IDE software, download it from arduino.cc/downloads. We're using version 1.8.2. Once the IDE is installed, unzip our source code download and

copy the contents of the libraries subfolder into the same of the Arduino IDE folder. Shut down the Arduino IDE if you have it open and restart it. Select 'File > Open' and load in the GaragePark v1.ino source code. At this point, plug the Arduino Nano microcontroller board into your PC's USB port with an appropriate cable. Your PC should find it and begin installing the necessary driver software automatically, so let it do so.

Once completed, go back to the IDE menu, select 'Tools > Board' and choose 'Arduino Nano' from the list. Now, select Tools again and this time, choose Port and select the COM port that isn't COM1 (that's your mouse). When you're ready, click on the green right-arrow icon top-left (the 'upload' button), the Arduino IDE will compile the source code and flash it to the Arduino board. You'll see the Nano board's built-in LEDs flash as the code is uploaded. After that, you should be good to go.

MUST READ: TESTING

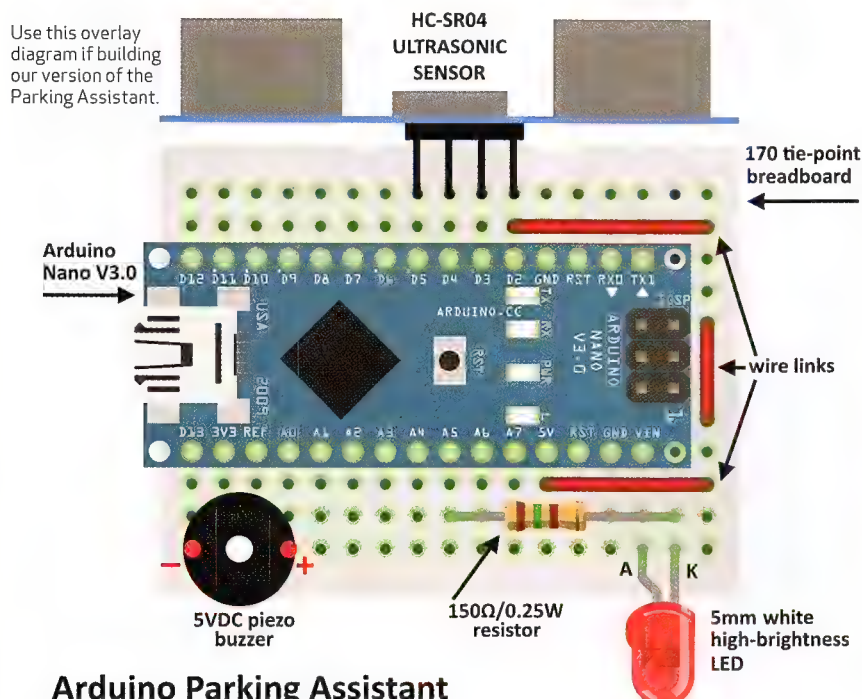
You can test the Parking Assistant by simply moving your hand in front of the ultrasonic sensor — start from a metre or so away and slowing bring it closer. As your hand crosses each warning distance threshold, you should see/hear a change in the output (you can adjust these in the source code before you flash to the Arduino Nano). If you're going to use it with your car, remember you need to travel slowly, not roar in like you're hammering across Mt Panorama. Make sure you vertically and horizontally align the ultrasonic sensor with your vehicle's furthest extremity as that'll obviously be the first thing that hits a wall if you get it wrong. That may also require you to separately mount the LED higher so you can see it.

The other thing you need to make sure of is that the sensor can actually pick up reflected waves from your vehicle. The ultrasonic waves have to reflect off your vehicle and back to the sensor's receiving unit for this to work — if, for some reason, the vehicle doesn't reflect, the sensor won't register anything and you'll get no warning. So it's obviously important that you test this out in a controlled way before you use it for real.

Or in other words, don't blame us if you punch a hole through the back of your garage!

BUILD IT YOURSELF

Personally, I reckon there's no better feeling than being able to say you built something yourself. Not only do you learn bucketloads, but you get full control over how the device works and if it should break down, you can easily fix it yourself. And how many gadgets can you say that of these days? ■



Arduino Parking Assistant

Get real-time vehicle data with Python

Python is a computer language versatile enough to even read real-time data from your car's engine control unit. Darren Yates explains how.

I've got a bit of a 'car' thing going on with my masterclasses this month, so it seemed fitting that we look at how you can code Python to read the On-Board Diagnostic (OBD-II) data from your car's engine control unit (ECU) using a low-cost Bluetooth OBD-II dongle. We won't go in-depth on OBD-II – you can read more details in my Android masterclass back on page 100. But we will assume you have a Windows PC or laptop with Bluetooth on-board, plus an ELM327-based Bluetooth OBD-II device.

PYTHON-OBD

Just briefly, OBD-II allows external scanners to read real-time data and 'diagnostic trouble codes' (DTCs) from a vehicle's ECU and covers a huge range of parameters from vehicle speed to engine revs to fuel flow-rates. Mechanics use professional OBD-II diagnostic tools to check for correct brake operation during rego-checks.

What has this got to do with Python? Well, what makes Python so popular is not just how easy the language is to pick up, but the vast array of libraries available that make it easy to code up apps to do almost anything. One of

those many libraries is 'Python-OBD' and it's designed specifically to allow you to read the data coming through your vehicle's OBD-II port via low-cost ELM327-style Bluetooth-enabled dongles.

ELM327 COMMAND SET

Looking at these low-cost devices from a programming perspective, there's plenty going on. First, the microcontroller chip inside the dongle takes in data from the user through its Bluetooth wireless connection, which converts the data into the microcontroller chip's required RS232 serial format. This format is very similar to old-style AT modem commands. The chip then converts those commands into OBD-II data commands and sends them to the ECU over the vehicle's OBD-II data link. Return data coming back from the ECU is then re-converted from OBD-II back to RS232 format and transmitted to the user over the Bluetooth wireless connection.

So that we don't have to code those AT modem-style commands directly,



The ELM327-branded Bluetooth dongle we purchased for \$5 from eBay.

the Python-OBD library features application programming interfaces (APIs) to generate those commands and transmits them over your PC's Bluetooth connection to the dongle.

We won't go into the specific ELM327 AT command set here as it's not really necessary. However, if you're interested, you can read the table online (tinyurl.com/y97apvfu).

PAIRING UP YOUR DEVICE

Now before we get into the coding proper, you'll need to ensure that you pair up the OBD-II Bluetooth device with your PC's Bluetooth adapter. In Windows 10, check the Task Tray for the Bluetooth icon, right-click on it, select 'Show Bluetooth Devices' from the context menu, choose the OBD-II device via the 'Pair' button and enter the password (usually '0000' or '1234'). Next, jump into Device Manager, look under 'Ports (COM & LPT)' and find the COM port number being used by the OBD-II device (chances are it'll be the highest number listed and not COM1 – that's your mouse).

INSTALLING PYTHON-OBD

To give you an idea of our test setup, we used a 2012-era HP Pavilion dm4 notebook PC upgraded to Windows 10, with Python 3.6.1 installed and a low-cost ELM327-branded Bluetooth OBD-II dongle we purchased from eBay for about \$5.

If you don't have Python 3 yet, you can grab it free from www.python.org/downloads. Python-OBD doesn't come with the stock Python install, but you



Make sure you have a Windows PC or laptop with Bluetooth adapter ready.


```
Python 3.6.0 Shell
Python 3.6.0 (v3.6.0:41df79263a11, Dec 23 2016, 07:18:10) [MSC v.1900 32 bit (Intel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> import obd
>>>
```

If you can run 'import obd' in the Python Shell with no errors, you're good.

```
C:\Windows\system32\cmd.exe
C:\Users\Darren\AppData\Local\Programs\Python\Python36-32\Scripts>pip3 install obd
Collecting obd
  Downloading obd-0.6.1.tar.gz (48kB)
    100% |#####| 51kB 619kB/s
Collecting pycserial (from obd)
  Downloading pycserial-3.3-py2.py3-none-any.whl (189kB)
    100% |#####| 194kB 1.3MB/s
Collecting pint (from obd)
  Downloading Pint-0.8.tar.gz (161kB)
    100% |#####| 163kB 1.6MB/s
Installing collected packages: pycserial, pint, obd
Running setup.py install for pint ... done
Running setup.py install for obd ... done
Successfully installed obd-0.6.1 pint-0.8 pycserial-3.3
C:\Users\Darren\AppData\Local\Programs\Python\Python36-32\Scripts>
```

Run 'pip3 install obd' in the Scripts subfolder of your Python installation.

```
obdlogger_v3.py - C:\Users\Darren\Python Code\Python_EP_14\OBD-II\obdlogger_v3.py (3.6.1)
import obd
import time
import msvcr

print('----- Python-OBD Vehicle ECU Data Logger -----')
newFile = open(input('Enter filename for .CSV data log: '), 'w+')
count = 0
connection = obd.OBD(portstr="COM8",baudrate=19200,fast=False)
while not connection.is_connected():
    print("... waiting for connection ...")
    time.sleep(0.5)
print("----- CONNECTED to OBD-II DEVICE -----")

timeNow = time.time()
while not msvcr.kbhit():
    time.sleep(0.1)
    count += 1
    rRPM = connection.query(obd.commands.RPM)
    rSPEED = connection.query(obd.commands.SPEED)
    rELOAD = connection.query(obd.commands.ENGINE_LOAD)
    instance = str(time.time()-timeNow)+" "+str(rRPM.value.magnitude)+ \
        " "+str(rSPEED.value.magnitude)+" "+ \
        str(rELOAD.value.magnitude)+"\n"
    print(str(count)+": "+str(rRPM)+str(rSPEED)+str(rELOAD))
    newFile.write(instance)

newFile.close()
print("----- Data logging ABORTED. -----")
```

Our simple but practical OBD-II data logger for speed, RPM and engine-load.

command prompt window. To check the library has installed correctly, fire up Python and in the Python Shell, just type:

```
import obd
```

...and press the Enter key. If you don't get an error message, excellent – you're good to go. If you do, try repeating the process and check if you have conflicting versions of Python installed.

USING PYTHON-OBD

Now we're ready to write some code. The first thing we need to do is import the library again using the 'import obd' statement. After that, we have to establish a connection with the Bluetooth OBD-II dongle plugged into the data link connector on your vehicle. You can try to create a connection object with the command:

```
connection = obd.OBD()
```

However, this didn't work for us – we couldn't get a link. To make it work with the ELM327-branded Bluetooth OBD-II dongle, we had to add in a few more parameters and expand this command to:

```
connection = obd.OBD(
    portstr="COM8",baudrate=
    19200,fast=False)
```

We did have multiple Bluetooth devices paired (but not connected), which probably didn't help, as we think the Python-OBD library probably got stuck on a COM port not in use. But by setting the COM port manually, setting the baud-rate and telling the OBD function to not implement its 'fast' option to speed up access, we were able to connect to the device. Remember, this is in addition to having previously paired the device with your PC's Bluetooth adapter. If you haven't done that, the rest of this won't work.

Now once we have a connection, we're ready to begin sending commands to the vehicle's ECU. To do that, you send an OBDCommand using the 'obd' object we just created, the return data or 'response' comes back as an OBDResponse object.



can install it relatively easily using Python's PIP3 utility.

Open up a command/DOS prompt in the folder \users\<username>\AppData\Local\Programs\Python\Python36-32\Scripts. You should find the 'pip3' script here. You can launch the command prompt in Windows Explorer – first, open up that folder, then while holding down the left Shift key, right-click on the folder space and choose 'Open command window here' from the

context menu. Next, type in the command:

```
pip3 install obd
```

Pip3 is the 'preferred installer program' for Python version 3 – it automatically knows where to find the various public-catalogued Python libraries, greatly simplifying the process. When the installation is complete, you can shut down the

It sounds more complicated than it is, so here's an example command:

```
response = connection.query(obd.commands.SPEED)
```

What we're doing is using the query function of the 'connection' object to send the command 'obd.commands.SPEED' and we're expecting the return data to be deposited in the 'response' object. Another way you could do this is to put the command into an OBDCommand object and include that in the query, like this:

```
command = obd.commands.SPEED
response = connection.
```

query(command)

This is the way to do it if you want to programmatically select commands to send to the ECU. To print or obtain the data value in the response object, you can either assign the value or print it like this:

```
newSpeed = response.value.magnitude
print(response.value.magnitude)
```

For the most part, Python-OBDD is a really simple library to use and shouldn't take you long to get the hang of it.

But from a programming perspective, the key thing is to be aware of how certain commands affect your program code flow. For example, execute the standard query function (like the one shown left) and your code will stop until a response comes back from your vehicle's ECU – either the data you're expecting, or nothing. Why nothing? As we mention in the Android Masterclass earlier in this issue, there's no guarantee that every vehicle will support every OBD command.

For top-down command prompt/terminal-style apps, code-blocking isn't necessarily a deal-breaker, but for GUI apps, it's a shocker because your GUI won't respond to any mouse commands while it's waiting.

So Python-OBDD also comes with an alternative query method called 'asynchronous querying' and what this does is to set up a new code stream or 'thread' separate from the standard GUI thread to allow you to send off commands separately, yet still have your GUI app operation continue as normal.

LIST OF PYTHON-OBDD COMMANDS

If you've read the Android Masterclass this month where I talk about the Mode and PID numbers and having to send those across to the ECU, you don't have to worry about that here – the Python-OBDD library does all that leg-work for you. All you have to do is know the name of the command you want to send and for that, head to the Python-OBDD doc (python-obd.readthedocs.io).

FINDING COMMAND SUPPORT

But how do you identify which OBD commands a vehicle supports from those that it doesn't? The answer is another Python-OBDD function called 'has_command()'. This function looks into the internal look-up tables of the Bluetooth device to see whether a particular command is supported, returning the result as a Boolean value, that is, it'll return 'true' if it is supported and 'false' if it isn't. For example:

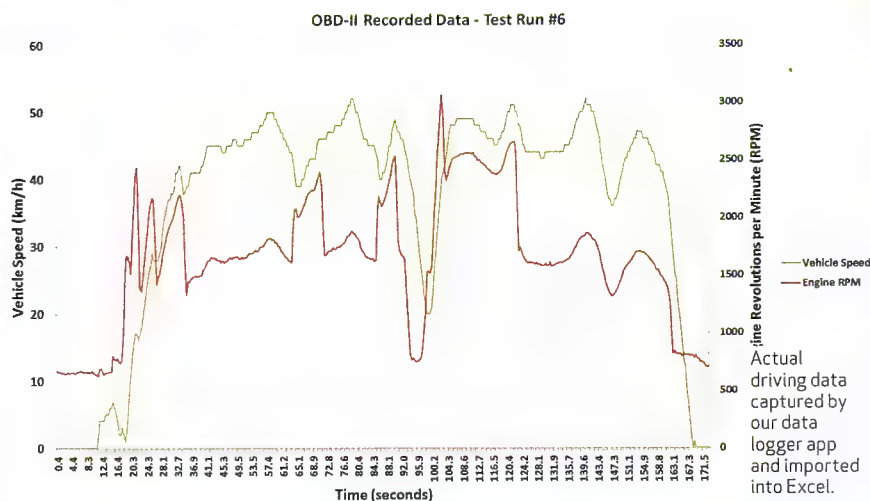
```
print( obd.command.has_command(obd.commands.SPEED) )
```

...looks up the OBD-II dongle to see if the 'SPEED' command is supported. The Boolean value returned is then displayed to the screen using the standard print() function.

OBDD DATA RECORDER APP

Now that we've got the basic nuts and bolts worked out, we're ready enough to build a small but useful data recorder app. The fact you can use these low-cost ELM327-style dongles to extract real-time data from the ECU

"What makes Python so popular is not just how easy the language is to pick up but the vast array of libraries available."



Enter the passcode for your device

Enter the passcode for your device

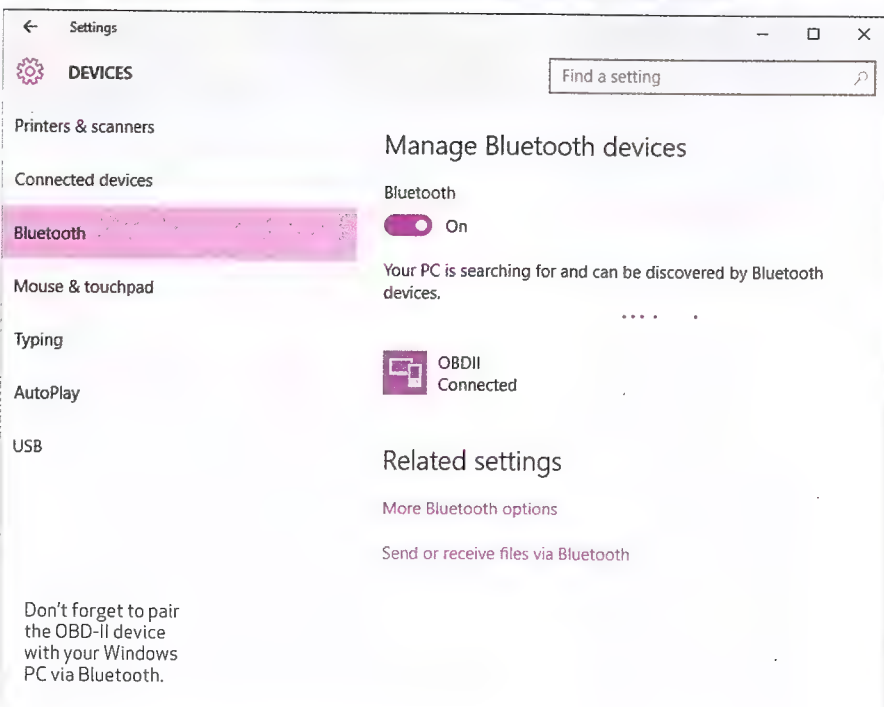
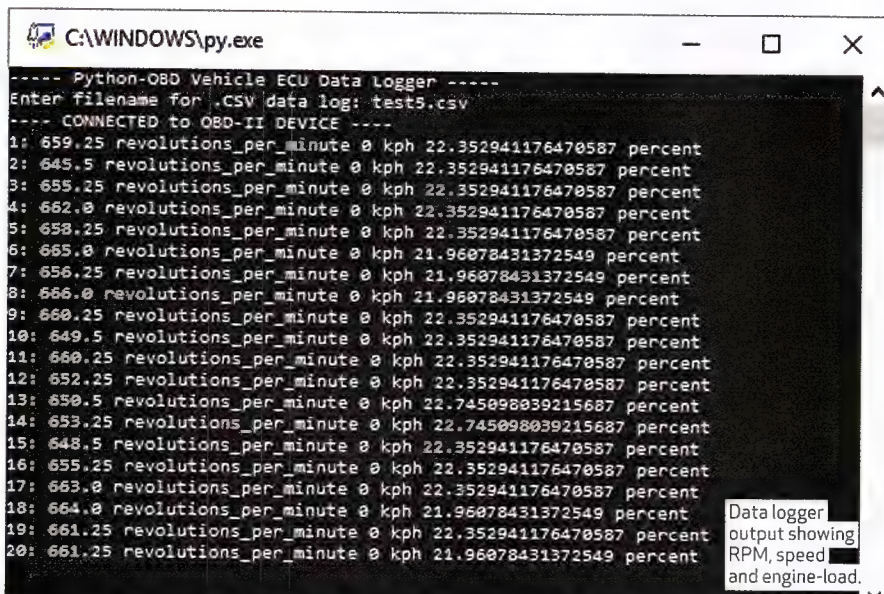
You might need to enter the same passcode into the device.

1234 X

Or, try entering a passcode on the device.

The Bluetooth password for most low-cost OBD-II devices is just '1234'.

Next Cancel



means we can continuously grab data and store it on file. For example, if we create a crude but simple .CSV (comma-separated-variable) file, we can capture data, import it into Excel or similar spreadsheet app and graph the data. You can find our OBD-II Data Logger app source code on the website at apcmag.com/magstuff.

However, it's about now just as you're getting practical that problems usually crop up – and the issue here is that data transfer from the ECU to the OBD-II dongle isn't instant. In fact, the data rates are, in some cases, as slow as old dial-up modems – in the kilobits-per-second range. So to keep things simple, we're not going to try to force our app to capture a particular number of samples per minute. Instead, we'll capture the time along with the sample

data and store both in our CSV file. That way, we still have an option for accurately detailing when the data samples occurred, even if we don't have full control to decide when they occur. But to prevent overloading the ECU, we'll also use the `time.sleep()` function to limit the sample rate to no more than two samples per second.

FILE I/O

We looked at how to use file operations back in the January 2017 issue of APC and the method we're using here doesn't have to be complicated. All we need is to open up a file for writing with a filename chosen by the user, write the data and close it when we're done.

But a quick word of warning here – if the user chooses a file that already

exists, the contents of that file will be wiped.

When then user presses the Enter key, the file is opened and we continue by opening up a connection to the OBD-II dongle. After confirmation of a connection, we begin sending commands to the dongle to hit the vehicle ECU for data using a loop. As the return data comes back, we format it, print it to the screen as well as add it to the CSV file.

However, in starting a loop, we also need some way to get out of it. We could choose a for-loop with a fixed number of samples, but a nicer way is to allow the user to press any keyboard key to exit the loop when they're ready.

To do that, we tap into the low-level functions of Microsoft's MSVCRT C++ runtime engine. The key function is `mscrt.kbhit()`, which is a simple Boolean function that fires out 'True' if a key is pressed; 'False' if not. Making this the condition of a while-loop means we can take samples until the user decides they've had enough and presses a key. At that point, we close the CSV file and we're done.

Note, too, that by using this Windows runtime engine, our code won't run on Mac OS X or Linux systems.

IMPORT INTO EXCEL

Since we've created a basic CSV spreadsheet file, importing it into your favourite spreadsheet app is easy. From there, you can do whatever analysis you like, or you can just turn the data into pretty pictures like the one we've included here.

One important point – if we don't use the 'value.magnitude' fields in writing data to the CSV file, we'll end up with cells that also include the units, for example, '45 kmh', which aren't typically helpful, so remember to use 'magnitude' field to get the value only.

BUYER BEWARE

We mentioned it earlier, but we'll mention it again. We purchased two Bluetooth-enabled OBD-II dongles from eBay and, despite featuring different versions of 'EM327' firmware, they both worked and we were able to successfully run our Python code on an HP Pavilion dm4 notebook PC with Windows 10 and capture data.

However, we can't guarantee these devices won't ever cause issues with your vehicle. We tested our purchased units on a 2005 Mazda 3 sedan with no obvious ill effects and while these devices are designed to be 'read only', you take the risk – just remember 'buyer beware'. ■

downtime

» GAMES: EDITED BY CARMEL SEAN

www
apc
RECOMMENDS

Don't overlook the Story Mode, as *Injustice 2* does an incredible job of making you feel invested across all 12 chapters.

PS4, X0 | \$79 | INJUSTICE.COM

Injustice 2

NetherRealm's second swipe at the DC roster doesn't require superhuman skills.

It doesn't matter where he pops up (usually in a cloud of smoke), Batman never fails to raise an eyebrow in his videogame appearances. This is a rich dude who straps pointy ears to his head and glides around his home city punching people in the face, yet he sees himself as morally righteous because he doesn't kill. A little brain damage is alright, though! *Injustice 2*'s story focuses on Batman's moral superiority, with DC's superhero roster forming two political sides: those who think the bad guys should be killed, and those who stand with the Batman.

If you're not familiar with *Injustice*, it's developed by NetherRealm Studios, the developer responsible for the *Mortal Kombat* series. *Injustice* is basically *MK* with its undies worn over its trousers; it's simply a reskin, hence why Batman can

uncharacteristically use a civilian as a weapon. Even the excellent Supermoves feel like less murderous Fatalities, triggering unskippable cinematics where Batman sends you into the sky on a fulton balloon, Joker straps you to a torture chair and Harley sets her hounds on you before bringing a baseball bat down on your face.

Unlike *MK*'s finishing moves, Supermoves are used mid-bout, hacking off a chunk of your opponent's

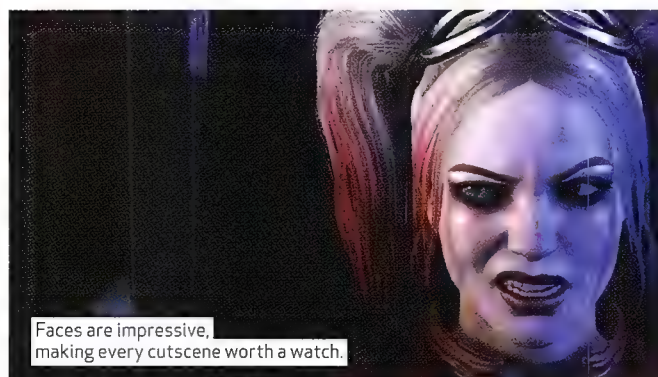
life bar (if the triggering hit lands) in exchange for your charged meter. You don't need to remember a bunch of different input sequences to pull *Injustice 2*'s big moves off, either – just wait for the meter to fill up, then press L2 and R2 together. Complexity comes from stringing together combos, but this is easily one of the most accessible fighting games ever made.

A lot of thought has gone into how a fighting game feels on a pad, so standard

moves are laid out logically across the face buttons. It's a simple, elegant system that never feels overwhelming.

There's no shortage of modes for solo players to get stuck into. The main event is the lengthy Story mode, which contextualises each fight with some gorgeously rendered cutscenes. For most key fights, you get a choice of two different characters across the mode's six-or-so hours, so you'll get your hands on most of the roster by playing along.

Injustice 2 is packed with content, so fight fans will have plenty to dig into, even when they get bored of getting their asses kicked online. ■ Kirk McKeand



Faces are impressive, making every cutscene worth a watch.

Verdict

An accessible fighter with just enough depth that it'll hold your interest even if you're playing alone.



In space, nobody can hear you
coo appreciatively.



PC | \$50 | ENDLESS-SPACE.COM

Endless Space 2

Dust off and begin your long journey to the stars.

After six months in Early Access, Amplitude's game of conquest enters a competitive field with much to distinguish it. It isn't the deepest space strategy game, but it might be the most pleasant to spend time with.

It really is gorgeous. There's a sense of style here that'll appeal to anybody who loves the fantasy of a 4X strategy game but finds the presentation dry. Amplitude knows when a bit of flare is necessary. Atmospheric cutscenes accompany colonisation and each battle can be viewed with a well-implemented 3D spectator system.

The soundtrack is great, too, as is much of its writing. Each of its eight factions is different, not just in how they play but the attitudes and themes expressed through their background and their questlines. There is a militaristic human faction, but it's hard to get excited about them when your alternatives include pacifistic space treants, time-bending robot refugees from a different universe, or a race comprised of clones of a single extremely vain

man. Each race engages with a mysterious substance called Dust and a vanished race called the Endless, which ties them into the history of not just this game but its predecessors – including *Endless Legend*, the fantasy spinoff.

At its core, this is a game about managing resources, research and fleets to expand your empire beyond its initial star system. The landscape of the generated galaxy you occupy has the potential to steer your progress, encouraging you to invest in particular tech pathways. You can begin a game with a plan, but that plan tends to be shaped by the type of galaxy you find yourself in. Each of our four playthroughs has felt meaningfully different as a result of this variety.

Endless Space 2 is a pretty traditional 4X game in that, if you're familiar with the genre, there's little to surprise you about the game's basic structure. Amplitude's skill, however, is in ensuring that you never interact with the game at that level without encountering a complicating factor arising from your faction or situation.

The interface is slick, good-looking and parse; however, it achieves this through the extensive use of shorthand and symbols, meaning our first hundred turns or so were spent making mistakes simply because we didn't 'get' what the UI was trying to tell us. Those frustrating early hours have the potential to put players off entirely, although perseverance is definitely rewarded.

The political system changes the balance of parties within your faction in response to your strategic decisions and is a very successful inclusion. Diplomacy with the AI... less so.

A launch-day update solved lots of the most serious issues hanging over from the game's time in Early Access, but it still left a laundry list of known bugs for Amplitude to work through. ■ Chris Thusten

Verdict

A good game now, but with inevitable patches and updates ahead, it will be better in six months' time.



The Elder Scrolls Online: Morrowind

We warden rush out to grab this one.

PC, PS4, XO | \$89.95

ELDERSROLLSONLINE.COM

If you're an MMO tart like us, you've wandered the massively multi-worlds of almost everything that's come to the local market. Very few have stuck around in my life longer than a few months, and there are even fewer worth sinking money into a subscription. We had all invested several hundred hours into *Skyrim*, so taking that to the MMO-stage sounded amazing. Not long after release, however, the playerbase dwindled, the game went free to play and I (we all) uninstalled.

Looking to remind us all *ESO* still exists, *Morrowind* adds its largest zone to date, Vvardenfell, as well as a new playable class, the Warden, while maintaining that free-to-play model. The environment team has done a tremendous job at varying the landscape throughout Vvardenfell. If you've played the old *Morrowind*, its landmarks and scenery might tug at the heart-strings through all that brown.

You can play any class, any way you want without restricting yourself to traditional MMO archetypes of 'tank', 'heal' and 'DPS'. You can essentially do all three by being able to kit yourself out with any combination of armour and weapons and talents.

Morrowind has taken me back to a place I loved for a short period of time, and then promptly reminded me why I stopped playing. ■ Troy Coleman





Dirt 4

A rally-racing sim that's as fun for casuals as it is detailed for the hardcore.

PC, PS4, XO | \$99.95
CODEMASTERS.COM

Any studio hoping to set the world ablaze with a rally sim needs to work extra hard nowadays. Titles such as *Forza Horizon 3* and *The Crew* are huge racing sandboxes that include not only rally racing but every other type of four-wheel racing under the sun. But despite the odds against it, it's safe to say that, even for casual racers repelled by the hardcore sim elements of last year's *Dirt Rally*, *Dirt 4* has much to enjoy.

Set across Australia, the US, Spain, Sweden and Wales, *Dirt 4* is a hell of a lot of fun. It's possible to play it as either a casual arcade-style racer or as a sim, and while fans of the former style will still find some aspects unforgiving, this package is a whole lot more focused than those bloated sandbox offerings mentioned earlier. The risk/reward rhythm of rally driving and the game's blistering speed make for a game both meditative and stressful.

In addition to the usual career mode, you'll also be able to create your own courses. This isn't a track editor per se, rather a tool which lets you determine the start and end points on the pre-existing stretches of road. But even if that's not your style, the huge variety of vehicles and challenges will be enough to keep you occupied. Plus, there's also the competitive challenges making *Dirt 4* a game that is sure to please most. ■ Shaun Prescott



PC, PS4, XO | \$77 | WWW.THESURGE-GAME.COM

The Surge

Souls? Where we're going, we don't need Souls.

Somehow, no-one's done this already. 'Sci-fi Dark Souls' is about as intoxicating as a three-word elevator pitch can be, and yet *The Surge* is the first to realise that idea. But there's much more here than just *Dark Souls* in space.

That *The Surge* owes a debt to From Software's classic is undeniable, and on first impressions, the similarities are obvious. Bonfires become medbays. "You Died", becomes "Vital Signs Not Found". Estus flasks become injectable stimulants. Souls become scrap parts, and every respawn sees you racing to reclaim what you were carrying when you died. And it's tough as nails, with boss fights, in particular, finding inventive ways to serve you your now-mutilated bum.

But then come the differences. While you initially start with a basic implant that allows you to recover a chunk of your health bar three times, this isn't compulsory. As you discover new implants, and unlock new slots in your robotic exoskeleton for them, you can extensively

customise protagonist Warren. When going up against a bloodthirsty boss, you might kit him out with extra health boosters, expanding the number of times you can heal. There are implant modules which recover health when you successfully land finishing moves, or one which trades energy for health. Or if your defence is fine, you might apply implants that give your attacks a boost. There's even the option of switching out the ability to see enemy health bars for something else, allowing for a breadth of tactical options.

Gear and weapons allow for more customisation, with weapons ranging from giant lumbering clubs and impractically large blades, to sword/chainsaw hybrids and rapid, flaming dual-fists. Delightfully, all of them feel great to slam into laser-firing drones, raging humanoid psychopaths and even accidentally into your NPC pals. Gear is the final piece of the customisation trinity, affording you the option of lumbering around in a bulky, high-defence suit or running rings around enemies in a riskier, speedier option. Acquiring

new gear, crafting the exact piece you want, or upgrading a current piece of armour all requires both scrap metal and specific parts dropped by enemies. Getting hold of these parts requires a bit of tactical nuance beyond concentrating on not dying. Unique here is the ability to select which body part to aim for. Bashing away at an unarmoured part will land you a quicker kill, but striking at a piece of armour or weaponry allows you the chance to slice it off and claim it for yourself.

Deck13 builds a remarkable sense of place with hazardous oranges and toxic greens lit with crackling neon beams or a blazing desert sun. The plot itself, however, is pretty standard sci-fi fare. It's not bad, but it's entirely predictable, which is a shame given how much originality is shown in other areas. ■ Alex Jones

Verdict

They say imitation is the sincerest form of flattery, but *The Surge* proves that reinvention can be even better.



The guy on the right thinks his arms are a match for big balls of deadly electricity.



PC, PS4, XO | \$99.95 | TK7.TEKKEN.COM

✓✓✓
apc
RECOMMENDS

Tekken 7

All you can beat.

Fighting games play an unusual role in today's gaming landscape: they're no longer the mainstream sensation they once were, but they're hardly a phenomenon appealing to a tiny niche either. Between the hardcore esports fighting scene – in which Tekken has always played a crucial role – and the casual living room button-mashers, there is a nice middle ground, and it's one Tekken can fit.

This middle ground is a place where players can find their footing, learn combos and how to play fighting games properly, without necessarily becoming good at them. Tekken 7's story mode is exemplary of this – it's a pedal-to-the-metal onslaught of neon-hued Japanese computer game ridiculousness, spliced with rudimentary third-person shooting sections and typically outlandish

narrative flourishes. Even for those ambivalent towards fighting games, this campaign is worth experiencing for its sensory relentlessness: it never lets up, is utterly bonkers and, to be honest, feels a bit like being on exotic drugs. [Ed – Don't do drugs, kids, or you'll end up writing about video games for a living.] For those among us who button mash their way through fighting games, the fact of never really knowing how to play properly will likely not even register.

Learning to play Tekken 7 isn't hard. Mastering it, on the other hand, can feel almost insurmountable unless you commit a huge chunk of time to it (you'll need to send your children to an orphanage, and quit your job, in other words). Given how notoriously technical Tekken can be by virtue of its three dimensions (most fighters only have two), playing

through the four-hour story campaign against AI will be satisfaction enough for most, though the same people are likely to get utterly demolished online: there are a lot of good players out there.

All the ingredients are here for a satisfying Tekken – the roster of fighters is massive and there are more than a dozen arenas in which to put them through their paces. Local 1v1 multiplayer is arguably the reason most would buy a fighting game, and T7 doesn't disappoint, though online play can sometimes be stymied by poor connectivity – possibly a symptom of living in the connectivity backwater that is Australia.

Those who purchase Tekken on day one already know why they're buying it: because they love technical fighting games. But for everyone else, especially the more casual player: is there

any point? There are plenty of casual local multiplayer games in this day and age, and fighting games aren't exactly welcoming once the novelty of the spectacle has diminished. But if you must have a fighting game in your library, it might as well be this one. Compared to Street Fighter V, it's bursting with content, and even if you're crap, it's just a really fun thing to behold.

The fighting game may become more niche with every year that passes, but the sheer pleasure of mindlessly bashing your controller in an effort to (accidentally) smite your foe is one that doesn't really get old. ■ Shaun Prescott

Verdict

A complex 3D fighting game that will appeal to the hardcore, but reserves some pleasure for casuals, too.





WannaCry even infected Victorian speed cameras

AND NOBODY SHED A TEAR.

With the world still reeling in the aftermath of the WannaCry ransomware attack, even more stories of infections are coming to light. While the attack reached governmental bodies across Europe, it even managed to infiltrate 55 speed cameras across Victoria. According to a department spokesperson, "a system patch has been applied" ensuring the virus doesn't continue to spread, and they're working to remove the WannaCry virus from the infected units. Unfortunately, for any motorist hoping to take advantage of these out-of-action cams, it has been reported that they're still all capturing speed accurately. Sorry.



The best use of AI so far? Sorting your Lego collection

ANOTHER BRICK IN THE WALL.

Jacques Mattheij, like most of us, had a Lego bag when he was a kid and dedicated many hours of his life to building. Now a grown man, he stumbled across an idea for an invention while dabbling in the online Lego trading market. He constructed a sorting machine using a series of conveyor belts, cameras, bins and air nozzles to first identify each brick as it travelled along the belt, then pop it into the correct bin. The identification stage was, by far, the hardest part of the construction, involving days of coding and working out how to classify each part — of which there are thousands. Finally, after two weeks, he could finally start sorting his Lego. You can read the full story of his invention here: tinyurl.com/apc444-lego ■

Self-driving cars can't handle our roos

"Hey, Skippy! Get off the road!"

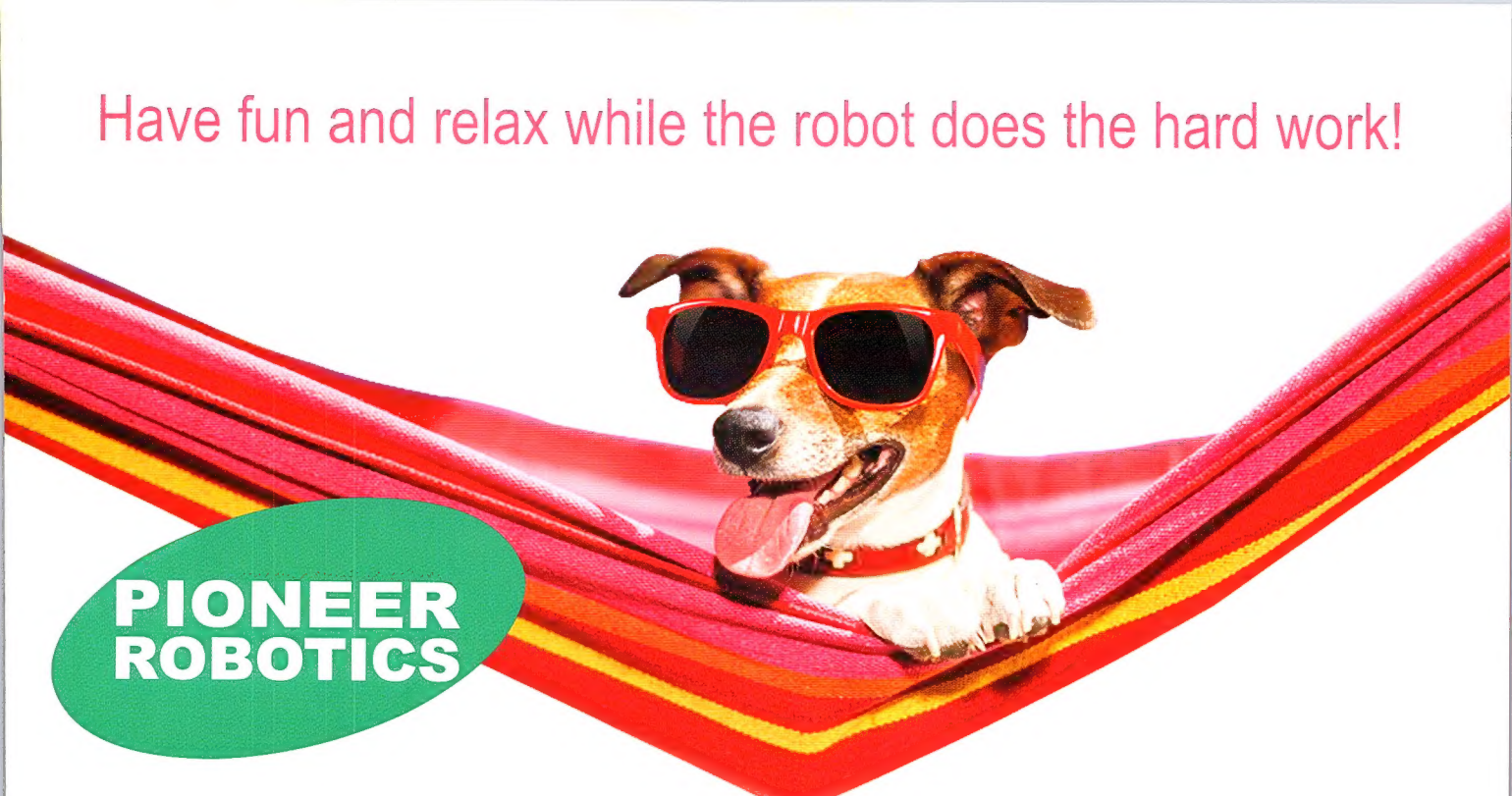
Anyone who's had to do a bit of country driving would be more than familiar with the threat of a kangaroo bouncing across the road mere metres from you. If you're lucky, you can slam on the brakes and everybody lives to tell the tale, but spare a thought for autonomous vehicles relying on detection software that simply doesn't know what to make of a large animal that is on the ground one moment and airborne the next. For at least the past two years, Volvo has been attempting to teach its cars how to detect the marsupials in the Tidbinbilla Nature Reserve in Canberra, but hasn't been overly successful.

E-cigarettes responsible for malware

NOT CANCER... YET.

While the long-term health effects of e-cigarettes is still an ongoing area of research, hackers have discovered that they can be used to transmit malware. As a mobile device, the vapers need to be recharged via a USB cable — and many would simply plug it straight into their computer. Security researcher Ross Bevington revealed how e-cigarettes, while plugged in, could interfere with a computer's network and even pose as a mouse or keyboard to then spread malware. Luckily, since the vapor is only capable of storing a small amount of data, it's unlikely they could transmit something on the scale of WannaCry. But just to be safe, if you partake, make sure your computer's security suite is up to date, or maybe just plug your vapor into a wall socket instead.

Have fun and relax while the robot does the hard work!

A small brown and white dog is lying in a red and yellow striped hammock, wearing red sunglasses and has its tongue out, appearing relaxed.

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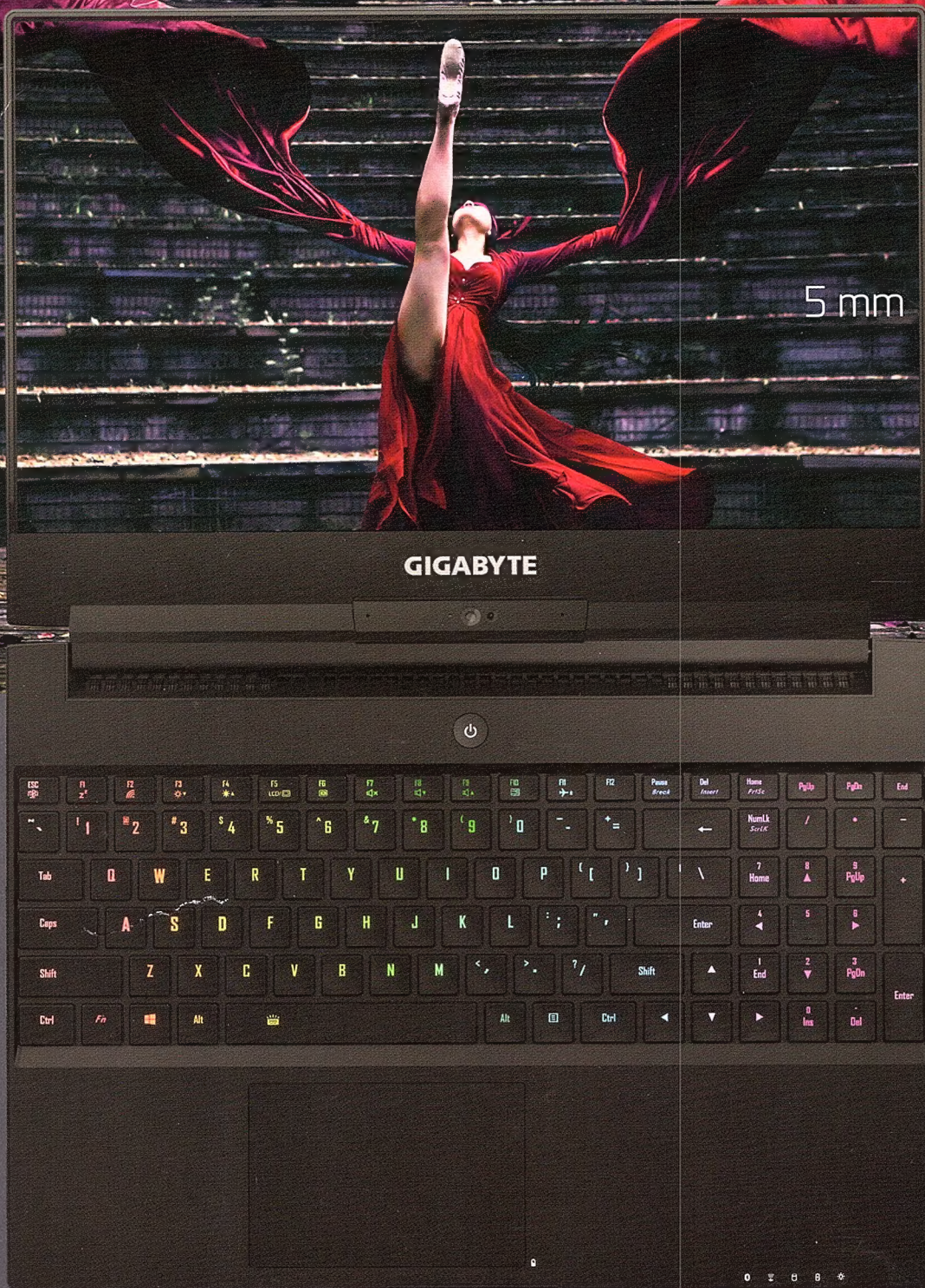
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